

ENVIRONMENTAL KNOWLEDGE, ATTITUDES, BEHAVIORAL INTENTION,
AND BEHAVIOR OF PRESERVICE ELEMENTARY TEACHERS
IN TAIWAN, THE REPUBLIC OF CHINA

By

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The purpose of this study was to examine environmental knowledge, attitudes, behavioral intention, and behavior of the preservice elementary teachers in Taiwan, R.O.C. An additional purpose was to explore the relationships between environmental knowledge, attitudes, behavioral intention, and behavior. A related purpose was to predict environmental knowledge, attitudes, behavioral intention, and behavior from their respective predisposing and sociodemographic variables. The subjects were 493 second-year students enrolled in the nine teachers colleges in Taiwan in 1992. The research instrument was composed of five scales to measure subjects' environmental knowledge, attitude, worldview, behavioral intention, and behavior. Included also were 10 items designed to collect subjects' sociodemographic information. The data were collected during the spring term, 1992.

The results indicated the subjects' environmental knowledge, attitudes, and behavioral intention were comparable to their western counterparts as measured using the same scales. The subjects were found to have high environmental behavior frequencies for not smoking, not using aerosol cans, keeping faucets from leaking, and turning off electric appliances and lights when no longer necessary. However, their behavior frequencies concerning recycling garbage, reporting pollution problems to authorities, and participating in activities sponsored by environmental organizations were extremely low.

The subjects' environmental behavior was correlated with behavioral intention and attitude, but not with worldview and knowledge. However, environmental behavioral intention was significantly related to attitude, worldview, and knowledge.

Environmental behavioral intention, experience of environmental education, and residence were found to be most significant predictors of environmental behavior. Environmental attitude and political ideology were most significant predictors of environmental behavior intention. Environmental worldview, knowledge, and a number of sociodemographic variables (economic condition, parental job, interested subject of study, and college location) were significantly related to environmental attitude. Environmental knowledge and academic discipline were

significantly related to environmental worldview. Subjects' environmental knowledge was significantly affected by college location and academic discipline. This study also examined a part of Green and Kreuter's PRECEDE model. It was concluded that environmental behavior, like health behaviors, can be predicated from its predisposing and sociodemographic factors.

CHAPTER I INTRODUCTION

Man has interacted with the natural environment since the inception of human history. However, the impact of man on the environment has caused severe deterioration only in the last two centuries.

Some researchers have indicated that the deterioration of the environment is caused by the synergistic effect of the traditional way of life and technological advances (White, 1967; Ehrenfeld, 1978; Catton & Dunlap, 1980). Technology and the development of industry further added to the problems caused by abuse of the natural environment. Environmental crisis has become a global issue. The environmental problems of underdeveloped areas of the world may be different from those of developed areas, but they are more serious and more urgent.

During recent years, the material lives of people in Taiwan improved markedly due to rapid economic growth and industrialization. However, in contrast to material life, the quality of the living environment remains poor. Citizens are concerned that environmental quality may continue to decline due to continued technological improvements. The more pollution is detected, the more

environmental movement grows. The government is concerned about the degradation of environmental quality and apprehensive about the environmental movement which may cause unrest in Taiwanese society. In 1987 the government published "Current Environmental Policy" as a guideline for improving the natural environment and preventing further degradation of environmental quality. In 1988 the government restructured the environmental protection agencies, both in central and local levels, to enhance their ability to solve environmental problems. In addition to rethinking the use of technology and legal regulation, the government also encourages and supports the solution of environmental issues through education.

Maloney and Ward (1973) contended that the ecological crisis is a crisis of maladaptive behavior. Human maladaptive behavior can be modified through planned education, and such education should be started as early as possible in order to foster life-long, responsible environmental behavior (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1980; Selim, 1977). Wilke (1985) indicated that the teacher is the key factor in successful school environmental education. Other environmental education experts also stressed the importance of the teachers' environmental education (Stapp, 1970; Roth, 1972). Hence, effective environmental education for teachers is the prerequisite for effective public

environmental education. It has been suggested that the goals of environmental education should include affective, cognitive, and skill areas of attitudes, values, and behavior (Bennett, 1974). According to Buethe (1975) and Rakow (1984), teachers tend to teach what they know and what they feel as well as serve as role models for their students. Therefore, it is important to determine a) what they know regarding the environment and related problems; b) how they feel about it; c) what commitments they are willing to make; and d) what commitments they do make as well as the determinants that predispose their thinking, feeling, and behavior concerning the environment and related issues (Bennett, 1974; Maloney & Ward, 1973). These determinations should be made prior to any attempts to improve teacher preparation in environmental education.

The ultimate goal of environmental education is responsible environmental behavior. Green and Kreuter (1991) indicated that no single behavior or action is caused by a single factor. Human behavior is influenced directly and/or indirectly by three major areas of factors, namely, predisposing, enabling, and reinforcing factors. Predisposing factors include a person's or population's knowledge, attitudes, beliefs, values, and perceptions that facilitate or hinder a behavior. Enabling factors are those skills, resources, or barriers that help or hinder a behavior. Reinforcing factors are factors subsequent to

behavior that provide the continuing reward, incentive, or punishment for behavior and contribute to its persistence or extinction (Green, Kreuter, Deeds, & Partridge, 1980). According to Green and Kreuter (1991), any behavior can be explained as a function of the collective influences of these three type of factors. Knowledge of these various factors affecting preservice elementary teachers' behavior concerning the environment may be very important in determining the success of environmental education in the future.

Purpose of the Study

The purpose of this study was to determine the environmental knowledge, worldview, attitudes, behavioral intention, and behavior of preservice elementary teachers in Taiwan, Republic of China. Specifically, this study was designed to

1. establish a baseline of information concerning preservice elementary teachers' environmental knowledge, attitudes, and behavior;
2. provide useful information for developing new or revised curriculum to strengthen environmental education in the professional preparation of elementary teachers;
3. identify future areas for research to promote environmental education throughout the educational system;

4. investigate the relationships among environmental behavior, behavioral intention, attitudes, and knowledge among preservice elementary teachers; and

5. use portion of the PRECEDE model to determine the predictability of behavior, behavioral intention, attitudes, and knowledge from a combination of sociodemographic variables and their predisposing factors.

Statement of Research Problem

The study has been designed to examine the following eight questions:

1. What are the environmental knowledge levels, attitudes, behavioral intention, and behavior of preservice elementary teachers?

3. What are the relationships among environmental behavior, behavioral intention, attitudes, and knowledge of preservice elementary teachers?

4. To what extent can selected predisposing and sociodemographic variables predict environmental behavior of preservice elementary teachers?

5. To what extent can selected predisposing and sociodemographic variables predict environmental behavioral intention of preservice elementary teachers?

6. To what extent can selected predisposing sociodemographic variables predict environmental attitudes of preservice elementary teachers?

7. To what extent can environmental knowledge and selected sociodemographic variables predict environmental worldview of preservice elementary teachers?

8. To what extent can selected sociodemographic variables predict environmental knowledge of preservice elementary teachers?

Null Hypotheses

Hypothesis 1. No association exists among environmental behavior, behavior intention, attitudes, worldview, and knowledge.

Hypothesis 2. No association exists among environmental behavior and selected predisposing and sociodemographic factors.

Hypothesis 3. No association exists among environmental behavior intention and selected predisposing and sociodemographic factors.

Hypothesis 4. No association exists among general environmental attitudes and environmental knowledge and sociodemographic factors.

Hypothesis 5. No association exists among environmental worldview and environmental knowledge and sociodemographic factors.

Hypothesis 6. No association exists among environmental knowledge and sociodemographic factors.

Need for the Study

Environmental concern of preservice elementary teachers plays a major role in future elementary environmental education. This study attempted to assess environmental behavior, behavioral intention, attitudes, and knowledge of preservice elementary teachers. This study also was designed to predict the preservice teachers' environmental behavior, behavioral intention, attitudes, and knowledge from a combination of sociodemographic factors and some selected predisposing factors. The results of the study could provide educational authorities as well as teacher educators information to improve environmental education in elementary teacher education.

In addition, because this study incorporated measures that have been used in several countries as research instruments, the results from these measurements could provide valid information for cross-cultural study concerning environmental education.

Delimitations

1. The study was delimited to the second-year students enrolled in the nine teachers colleges during the spring semester of 1992 in Taiwan, Republic of China. The generalizability of the study results is limited to students of similar background.

2. To increase the precision of translation, the validity of the Chinese version of the questionnaire was

checked by a Chinese-American professor and three Ph.D. students with research experience related to the present study.

3. A stratified random sampling procedure was adopted to increase the representativeness of the sample.

Limitations of Study

The study contains the following limitations:

1. The students' self-reported environmental behavior, behavioral intention, and attitudes may have reflected memory lapses and normative response bias.

2. The survey instrument may not have been able to operationalize the concepts. Difficulty in translating the questionnaire into Chinese might be encountered due to the differences in word usage, and students may have also misinterpreted the questions.

3. The extrapolation of the study results may be limited due to cross-cultural differences.

4. Students' responses may be varied due to different environment and such individual factors as boredom, fatigue, and differing attitudes toward the survey.

Assumptions

The present study contains the following assumptions:

1. The second-year students are representative of preservice elementary teachers in Taiwan.

2. These preservice elementary teachers responded to the questionnaire to the best of their knowledge.

3. The respondents were not sensitized by similar instruments used in the present study.

Definition of Terms

The operational definitions of key terms in the study are as follows:

Preservice elementary teachers refer to students who are enrolled in the nine teachers colleges in Taiwan, Republic of China. These students will be future elementary school teachers. Inservice elementary teachers refer to teachers who are currently teaching in elementary schools.

Environmental behavior refers to the behavior measured by the Environmental Behavior Scale used in this study.

Environmental behavioral intention refers to the behavioral intention measured by the Environmental Behavior Intention Scale used in this study.

Environmental attitudes refer to the attitudes measured by the Weigel's Ecological Concern Scale (Weigel & Weigel, 1978).

Environmental worldview refers to the attitudes measured by the New Environmental Paradigm (NEP) Scale (Dunlap & Van Liere, 1978).

Sociodemographic variables refer to age, gender, current academic major, senior high course concentration, experience of environmental education, residence, region of school location, self-reported family economic condition,

parental job specification, and self-identified partisan ideology of participating students.

Predisposing factors of environmental behavior were defined as environmental behavior intention, environmental attitudes, environmental worldview, and environmental knowledge; predisposing factors of environmental behavior intention were defined as environmental attitudes, environmental worldview, and environmental knowledge; predisposing factors of environmental attitudes were defined as environmental worldview and environmental knowledge.

CHAPTER II REVIEW OF THE LITERATURE

Introduction

The purpose of this study was to investigate environmental knowledge, attitudes, intention, and behavior of preservice elementary teachers in Taiwan, Republic of China. An additional purpose was to examine the relationships among environmental behavior, intention, attitudes, knowledge, and a number of sociodemographic variables.

The review of literature is presented in the following sequence:

1. environmental education and its related issues;
2. instruments used to measure environmental concerns;
3. factors affecting environmental concerns;
4. relationships among environmental knowledge, attitudes, behavioral intention, and behavior;
5. assessment of preservice and inservice teachers' environmental knowledge, attitudes, and behavior; and
6. summary.

Environmental Education and Related Issues

Environmental education is a relatively new field in education compared to related fields such as science education and health education. Since its inception in the

late 1960s, environmental education has received much attention. Three international conferences sponsored by the United Nations in the 1970s drew the attention of international educators and experts. The discussion of goals, definitions, strategies, and related problems has helped the development and progress of environmental education. The U.S. government passed the Environmental Education Act in 1970 and revised it in 1990 to ensure its implementation across all disciplines as well as all grade levels (Marcinkowski, 1991). However, implementation has been reported as being slow in progression and leveling off in recent years (e.g., Edralin, 1989; Simmons, 1991; Gigliotti, 1990). The major constraints to development, implementation, and evaluation have been attributed to the following: a) educational material is increasingly organized around disciplines, and little emphasis is placed on problem solving; b) curricula are already crowded with subject matter, and therefore it is difficult to persuade administrators to incorporate additional areas of study into the school day; c) environmental education cannot avoid value questions; and d) there is a severe shortage of classroom teachers who are prepared to effectively integrate environmental education into instructional programs (Stapp, 1974).

Problem of Definitions and Goals

Definition is the fundamental guideline for goal setting for curricula and programs and their subsequent evaluation and implementation. Gigliotti (1990) stated, "Depending on which outcomes and type of evaluation you consider, environmental education can be evaluated in both positive and negative ways" (p. 9). A majority of environmental education curricula focused on environmental awareness (Arcury & Johnson, 1987; Volk, Hungerford, & Tomera, 1984). Gigliotti (1990) commented that current environmental education has produced environmentally concerned citizens who are willing to fight against environmental misdeeds of others but lack knowledge and conviction in their role in the environmental problem. He further suggested that we need to plan for change and that we cannot continue to produce environmentally illiterate teachers.

Volk, Hungerford, and Tumera (1984) conducted a nationwide survey in the U.S. of environmental educators' perceptions of the need of environmental curriculum. These researchers summarized the results as follows: a) environmental education was considered important at each academic level and increased in importance with each succeeding academic level; b) environmental educators believed that existing curricula could not accomplish the goals for environmental education as stated by UNESCO; c)

lower-level goals were perceived as having been accomplished more than higher-level goals; d) at each academic level, the perceived importance of the goals exceeded their accomplishment; e) a substantial need for new curricula was presented at each academic level; f) the need for teacher education was perceived to be a major need at the elementary and secondary levels; g) new curricula addressing ecological foundations and level of awareness of goals gained greater use at elementary and middle school levels. Volk et al. (1984) concluded that environmental educators failed to verify the priority of goals because these educators stressed the importance of lower-level goals (ecological foundation knowledge, awareness of issues and human values), rather than higher level goals (investigation/evaluation of issues and solutions, citizenship action).

Inconsistent views regarding the priority of goals of environmental education among environmental educators also were reported (Simmons, 1991; Adams, Biddle, & Thomas, 1988). Simmons (1991) surveyed 1,225 natural science and environmental education centers throughout the United States. Knowledge (natural study) was the most frequently mentioned goal (76.1%). The second most frequently mentioned goal was sound environmental behavior (74.4%), followed by teaching natural history (71.5%) and influencing peoples' attitudes (66%). The results of this study indicate that the development of learners' environmental

attitudes has been somewhat neglected by environmental educators. Inconsistent views about goals of environmental education also have caused disagreement in curricula design as well as in course content (Pettus & Teates, 1983; Barnes, Rivner, Smith, & Waln, 1979).

Teachers' Ability to Teach Environmental Education

Numerous studies have indicated that teachers do show a positive attitude toward teaching environmental education, but they were perceived as not competent enough to teach environmental education. Peyton and Hungerford (1980) investigated preservice and inservice teachers' abilities to identify, teach, and implement environmental action skills in three midwest universities. This research indicated that teachers felt confident to teach but were unable to prepare curricular materials dealing with environmental action skills. Beiswenger, Sturges, and Jones (1991) investigated 450 elementary teachers' self-perceived knowledge of 22 topics related to water resources. These teachers expressed that they had inadequate knowledge about the majority of these topics. The researchers further indicated that teachers failed to give these topics any priority in the curriculum.

Ham, Rellergert-Taylor, and Krumpe (1988) reviewed existing studies and reported the following barriers to teachers: a) conceptual barriers stemming from lack of consensus about the scope and content of environmental

education, b) logistical barriers stemming from a perceived lack of time, funding, instructional resources, suitable class size, etc., c) educational barriers stemming from teachers' misgivings about their own competence to conduct environmental education, and d) attitudinal barriers stemming from teachers' attitudes about science and environmental education instruction. The researchers offered the following suggestions: a) effort should be directed toward integrating environmental education into other curricular areas besides science, b) school district newsletters might be established for sharing environmental education resources among teachers and schools, c) each school district should compile an environmental education library of instructional materials for each grade level, and d) the goal of environmental education for inservice training should be to eliminate or reduce known barriers.

Approaches to Encourage Environmental Behavior

Nearly all approaches used to encourage behavior in related fields have been recommended to environmental education. These approaches have been clearly reviewed (Cook & Berrenberg, 1981). Yambert and Donow (1986) proposed teaching environmental education as a basic code of ethics or religion. Swan (1974) cautioned that methods utilizing fear and guilt have been used too much. Providing fundamental ecological knowledge and fostering positive environmental attitudes are supported by a majority of

environmental educators (Volk et al., 1984; Stapp, Caduto, Mann, & Nowak, 1981; Bennett, 1974).

Ramsey, Hungerford, and Tomera (1981) indicated that an action-oriented approach is the most effective teaching strategy for environmental problem solving. However, Monroe and Kaplan (1986) argued that learning by doing may not be the most effective strategy. Based on the results of a survey of Michigan educators, they concluded that case studies and talking about what others do to solve environmental problems were more important.

Numerous surveys as well as experimental studies including workshops, symposia, and short-term training have been used to examine the effects of different curricula and teaching strategies. The majority of these studies confirmed that while the effects of environmental education programs varied, they tended to benefit both teachers and students.

In conclusion, environmental education has received considerable attention since its inception in late 1960s and rapid growth in the 1970s. Both schools and communities are regarded as necessary settings for the implementation of environmental education. Environmental education experts caution about the overuse of teaching strategies utilizing fear, guilt, and morality. Inservice teacher training on environmental education topics was regarded as a priority for teacher education. However, some crucial problems such

as length of the training period and location of training as well as teachers' lack of willingness to participate have limited its effect. Due to its multidisciplinary and interdisciplinary nature, environmental education has been found to be difficult to integrate into existing school curricula. A fundamental approach to solving environmental education problems in the long run is based on carefully implemented and evaluated environmental education curricula and programs in preservice teacher education institutions.

Instruments to Measure Environmental Concerns

When the environmental crisis started gaining public attention, there were numerous measurements developed to gauge the extent of an individual's concern about the environment and related problems and issues. Gray (1985) classified these measurements into four types--general, single topic, multiple topic, and multiple component.

General measurements are constructed with the intent to tap broad general attitudes toward the environment. They tend to be more affective than cognitive and also may emphasize behavioral intent. Some examples are those developed by Edgar (1971), Weigel and Weigel (1978), and Dunlap and Van Liere (1978). Edgar's (1971) Science, Nature, and the Survival of Man (SNSM) scale contained 19 items measuring broad, general attitudes toward ecology. Weigel and Weigel's 16-item Environmental Concern Scale served the same purpose. However, a closer examination of

the 16 items in the scale revealed that the majority of these items tended to focus more on pollution and conservation. The 12 items in Dunlap and Van Liere's (1978) New Environmental Paradigm (NEP) were intended to measure fundamental feelings toward the environment or an environmental worldview.

Single topic measurements are aimed at specific referents such as energy or conservation. Jackson's (1985) Environmental Attitudes Scale is an example.

Multiple topic measures are designed to measure a number of specific environmental topics such as pollution, population, and awareness of or feelings about these topics. The scale developed by Ramsey and Rickson (1976) is for this purpose.

Multiple component measures are designed to measure the traditional attitudinal components of cognitive, affective, and conative separately. The environmental inventory of Maloney, Ward, and Braucht (1975) is an example. This inventory contains four separate sections. The reliability and validity of each section has been established. Three of the scales directly measure the three traditional attitude components--knowledge, affective, and intention. A fourth scale is a self-report measure of behavior (not just intent), called "actual commitment." The inventory is designed to measure general environmental concerns. However, items in the inventory focus to some extent on

pollution and conservation. Bennett (1989) indicated that, using multiple measures, researchers can obtain a much broader data base for making judgments about outcomes in which they will have greater confidence. Preservice elementary teachers are the main source of elementary teachers in the near future. As mentioned in Chapter I, in consideration of the future impact of these teachers on our younger generation, a comprehensive evaluation of their environmental concerns is indispensable before the implementation of any environmental education program. Hence, this study utilized multiple component measurements to assess environmental concern.

Measurement of Environmental Attitudes and Behavior

Scales and inventories have been the dominant instruments for measuring environmental attitudes and behavior; however, there are still a number of researchers who prefer to use single item measures (e.g., Edralin, 1989; Chu, 1990; Horsley, 1984). In many cases, single item measurements have proved adequate for the assessment of particular environmental attitudes or concerns. There are, however, potential drawbacks to this method. The most serious problem concerning the single item method is its reliability (Ajzen, 1988).

An important issue in the measurement of environmental concern is the low correlation or inconsistency between environmental behavior and attitudes. Theorists have agreed

for some time that attitudes are better predictors of behavior when the attitude and behavior are measured at the same level of specificity. General attitudes about a group of objects are not expected to be good predictors of specific actions involving some particular subunit of the general class (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1977; Wicker 1969). Ajzen (1988) argued that attitude measures should be most predictive of behavior in situations which occur repetitively within the common behavior context of individuals.

Heberlein and Black's (1976) experimental research is an example of explaining this issue. They studied correlations among four levels of specificity of environmental attitude measures, using leaded and unleaded gasoline purchasing behavior as the criterion. In their experimental study, the correlations among leaded and unleaded gasoline purchasing behavior and environmental attitudes ranged from $r=.118$ to $r=.594$, according to the level of specificity of the attitudinal measurements. All attitude measures significantly correlated with the behavior measure. The results indicated that the more specific the attitude measured, the stronger it correlates to the behavior measure. Other studies conducted on different populations also showed results similar to those of Heberlein and Black (1976). The findings of these studies supported the idea that attitude measures that are more

specific to a given behavior are better predictors of that behavior than are more general measures.

On the other hand, Weigel and Newman (1976) and Weigel (1977) indicated that attitude-behavior correspondence could be increased by broadening the scope of the behavioral measure. In their experimental study, Weigel and Newman selected a number of single behaviors concerning petition, litter pick-up, and recycling as their behavioral criteria and used a 16-item ecological concern scale as the predictor. The researchers found that the correlation coefficients between environmental concern measure and single behavior ranged from .12 to .57, with a mean of .22. When similar behaviors were combined to form scales (petition scale, litter pick-up scale, and recycling scale), the correlation between the attitude measure and the three behavioral scale measures increased to $r=.42$ ($r=.50$ for petition, $r=.36$ for litter pick-up, and $r=.39$ for recycling). When the three scales were combined to form a comprehensive environmental behavioral index, the correlation coefficient reached $r=.62$. Hence, to test respondents' general environmental concern, the behavioral index must be comprehensive.

Heberlein and Black's (1976) suggestion of specific attitudinal measures and the suggestion of Weigel and Newman (1976) to broaden the scope of the behavioral measure appear to be important in environmental behavior research. On the

other hand, some researchers criticized that studies using single attitude measures and attempting to relate them to specific behaviors on a one-to-one basis are too simplistic to predict or understand the dependent variables (Kuhn & Jackson, 1989). These researchers suggested including the measurement of environmental worldview such as Dunlap and Van Liere's (1978) New Environmental Paradigm (NEP) for studying environmental attitudes. Heberlein and Black (1976) also indicated that general attitudes are important to study, not only because they predict a single behavior well, but also because they influence a wide range of specific beliefs and, indirectly, a number of behaviors.

Measurement of Environmental Knowledge

Knowledge refers to the ability to recall something from memory. Understanding, however, occurs at a higher cognitive level and involves comprehending the meaning of something and being able to explain it (Bennett, 1989). Environmental knowledge usually is divided into three categories--facts, principles, and theories (Gray, 1985). Environmental educators paid more attention to the evaluation of knowledge of the biophysical environment in the 1970s (Stapp, 1970; Bennett, 1974). Recent studies have stressed the importance of evaluating knowledge beyond its traditional scope, such as knowledge in skills and knowledge in action strategies (Hungerford & Volk, 1990; Peyton & Hungerford, 1980). Bueth (1975, 1985) included

environmental awareness as a component of knowledge measurement. However, other researchers separated environmental awareness from environmental knowledge (e.g., Kuo, 1987; Tsung, 1990). Gray (1985) indicated that self-reported or self-perceived environmental knowledge measurements are unreliable. Researchers recommended the measurement of knowledge beyond a true/false format for higher-grade-level respondents (e.g., Anspaugh, 1987). Items in knowledge scales used by a majority of researchers tended to tap fragmented, isolated facts. For example, item 1 in Wong's (1991) knowledge scale asks, "Which of the following elements makes up about 80% of animal body, plant, or human food: a) carbon, b) hydrogen, c) oxygen, d) nitrogen?" What is being measured here is merely a fragment of knowledge of fact. Gray (1985) contended that a fragment of knowledge probably will not influence a behavior. He stressed the importance of a test to measure knowledge of principle and theory. In assessing environmental knowledge, Gray (1985) further indicated that two critical differentiations should be made--factual versus principle knowledge, and long-range interdependency consequences versus short-term, isolated consequences.

Factors Affecting Environmental Concerns

There are many variables that are associated with responsible environmental behavior. In a review, Hines and Hungerford (1984) summarized that a) general environmental

knowledge such as knowledge of environmental issues and causes and consequences of pollution were shown to be significant variables in predicting environmental behavior; b) the affective factors of appreciation of natural beauty, emotional concern, beliefs, and attitudes appeared to be related to environmental behavior; c) personal experience in environment-related activities expresses environmental behavior; d) intention to behave in environmentally responsible ways might not accurately reflect the individual's behavior; and e) the influence of personality factors such as level of moral reasoning and locus of control on environmental behavior was inconclusive.

The reviewers noted that the research does not provide a clear picture of the relationships among variables related to environmental behavior. Based on the assumption of linear relationships among knowledge, affective, intention, and behavior, many researchers indicated the need to study these variables as predictors of environmental behavior (Bennett, 1974; Borden & Schettino, 1979).

In another dimension, environmental sociologists stressed the importance of sociodemographic factors in influencing environmental behavior (Dunlap & Van Liere, 1978), even though low correlations among sociodemographic variables and environmental concerns have been indicated (e.g., Hines, Hungerford, & Tomera, 1987).

The following section first reviews the impact of sociodemographic variables on environmental concerns, and then the studies concerning environmental knowledge, attitudes, behavioral intention, and behavior concerning college students.

Sociodemographic Variables and Environmental Concerns

In the past few decades, researchers not only have paid attention to public attitudes toward environmental issues and problems, they also have shown a great deal of interest in determining the impact of sociodemographic factors on environmental concerns. Age, sex, residence, political ideology, education, income, and occupation are variables that have received the most attention. However, the association among environmental concerns and these variables remains controversial. Harry, Gale, and Hendee (1969) suggested that age is positively correlated with environmental concern. However, most studies have not supported this contention. Malkis and Grasmick (1977) argued that young people are less integrated into the economic system or, more generally, the dominant social order; hence, they are expected to express more environmental concern. Hornback (1974) also indicated that solutions to environmental problems often are viewed as threatening to the existing social order, and they also could require substantial changes in traditional values, habitual behaviors, and institutional structure. McEvoy

(1972) stated that because males are more likely to be politically active, more involved with community issues, and have a higher level of education than females, they would be more concerned about environmental problems. Conversely, Passino and Lounsbury (1976) argued that males are more likely than females to be concerned about jobs and economic growth, and thus are less concerned than females about protecting environmental quality. Tremblay and Dunlap (1978) suggested that urban residents are more likely to be environmentally concerned than rural residents because they generally are more exposed to higher levels of pollution and other types of environmental degradation. On the contrary, other researchers suggested that since rural residents are closer to the natural environment, they are expected to express more concern with the environment than urban residents (Buttel & Flinn, 1974a; Williams & McCrorie, 1990). Dunlap (1975) suggested that Democrats and liberals are more concerned about environmental quality than are their Republican and conservative counterparts. However, Buttel and Flinn (1976) argued that support for environmental reform varies among political groupings. Morrison, Hornback, and Warner (1972) maintained that members of the lower class have experienced only poor economic conditions, and thus are less aware that they live, work, and play in polluted, overcrowded conditions; hence, they are less likely to be concerned about environmental

quality. On the other hand, Buttel and Flinn (1978) argued that because the lower working classes typically reside in highly polluted areas, work in poor physical environments, and have poor access to recreational facilities, they should be expected to express concern about poor environmental conditions. Freudenburg (1991) indicated that unless greater attention is devoted to specific environmental issues that have the greatest local salience, it is difficult to differentiate which groups have low or high levels of environmental concern.

The inconsistent findings and the controversial explanations led Van Liere and Dunlap (1980) to reexamine these sociodemographic variables related to environmental concern by a review of existing literature. The reviewers concluded that among the variables reviewed, only age, education, and political ideology were consistently associated with environmental concern. However, a recent study reexamined Van Liere and Dunlap's work and indicated that sociodemographic variables were ineffective in explaining environmental concerns (Samdahl & Robertson, 1989). The research of Van Liere and Dunlap (1980) and Samdahl and Robertson (1989) was limited to studies conducted on the general public. The influence of sociodemographic factors on the environmental concern of a homogenous population such as college students needs to be examined.

Gifford, Hay, and Boros (1983) compared environmental behavior and behavior intention of a college sample according to gender, age, academic major, years in college, and environmental education experience. The researchers indicated that only gender and environmental education experience correlated with environmental concern. The other variables--age, academic major, and years in college--showed no association with behavior or behavioral intent.

Recently, Hine and Gifford (1991) investigated correlations between seven sociodemographic variables and environmental concern using a sample of Canadian university students. None of the variables was significantly related to overt environmental behavior. Among the variables, only political orientation was significantly correlated with verbal commitment.

Wang and Tseng (1991) reported that elementary teachers' environmental attitudes and environmental behavior varied according to sex, age, and school location. Tsung (1990) indicated female elementary teachers had greater concern about the environment than male teachers, and rural teachers showed less environmental concern than urban teachers.

A number of studies indicated that current academic major correlated with college students' environmental concern (Wong, 1991; Gifford et al., 1983). Senior high school students in Taiwan are required to choose a

concentrated study area in either natural science or social science at the beginning of the second-year of their three years of study. Course concentrations for the two areas are different. Accordingly, a majority of natural science students are expected to enroll in a science-related major in a college or university. On the other hand, social science students are expected to further their studies in a humanistic or social sciences field. Differences in high school concentration area have been reported to affect students' science concern (Narchi, 1991).

Studies Involving Environmental Knowledge

Studies of environmental knowledge have been carried out extensively in elementary and secondary schools (e.g., Designer, 1981; Blum, 1987; Roth & Perez, 1989) as well as in the general public (e.g., Arcury & Johnson 1987; Arbuthnot 1977). However, studies of environmental knowledge of college-level students have been relatively few. There are several possible reasons for this. First, the development of a reliable and valid instrument has been very difficult. Second, respondents who are beyond the secondary school level often are reluctant to perform a test that may be considered as monitoring their intellect. Third, the procedure of administering a knowledge test has been a problem. For example, the use of a mailed questionnaire may result in disclosure of the test information, or the respondent may not be the person being

investigated (Aday, 1989). Arcury and Johnson (1987) cautioned that "given the importance of environmental knowledge in its own right and its possible causal relationship to environmental concern, opinion, and behavior, surprisingly little research has been reported on this subject" (p. 32).

Maloney et al. (1975) compared environmental knowledge of a sample of college students at the University of Southern California to a noncollege student group and a Sierra Club sample using a scale containing 15 environmental knowledge items. The researchers found that the college student scores fell between the other two groups. The Sierra Club group scored highest, the college group in the middle, and the noncollege group scored the lowest. The scores of the three groups were significantly different. Dispoto (1977) assessed environmental knowledge of 140 college students at Rutgers University by using the environmental knowledge scale of Maloney et al. (1975). The results indicated that science majors scored higher than their counterparts in the humanities. The researcher also indicated that environmental knowledge positively correlated with behavior. In addition, Dispoto compared his data with that of Maloney et al. and found that Rutgers University students were more knowledgeable than their California counterparts. Borden and Schettino (1979) studied environmental knowledge of 530 Purdue University

undergraduates. They found that female students were less knowledgeable than their male counterparts. Gifford et al. (1983) investigated environmental knowledge in a Canadian university student sample. The researchers cited the following findings: a) male students have more environmental knowledge than females, b) natural science majors were more knowledgeable and motivated than those majoring in social sciences or nonsciences, and c) students who were taking an environmental education course showed better knowledge, behavior intention, and behavior than those who were not.

In recent years some studies have been conducted to determine environmental knowledge in college students in Taiwan. Huang and Chiang (1991) studied environmental knowledge of junior college students in Taiwan and revealed that students were lacking in knowledge of waste disposal, population, sanitation, and safety. Students' environmental knowledge showed significant differences according to their demographic backgrounds. Male students were found to have greater knowledge than female students. Students in colleges in the northern and middle regions of Taiwan had more knowledge of the environment than their southern counterparts. Students from urban areas showed higher environmental knowledge than those from rural areas. Engineering majors had higher environmental knowledge than their nonengineer counterparts. The researchers concluded

that junior college students had inadequate environmental knowledge, based on performance on the knowledge test (mean score of 60%).

Chang, Chang, and Wang (1991) compared environmental knowledge of industrial (engineering) majors on junior college and university levels in Taiwan. Students' environmental knowledge was evaluated using a 20-item knowledge test developed by the researchers. The results indicated that junior college students' environmental knowledge was comparable to their university counterparts (84.91% versus 85.44%). They also reported that sociodemographic factors affected environmental knowledge.

Data concerning preservice elementary teachers' environmental knowledge are still lacking. It may be useful to study their knowledge by using published scales to facilitate across-countries comparisons.

Studies Involving Environmental Attitudes

Environmental attitude is the variable that has received the most attention by researchers. One of the reasons for this interest is that it has been regarded as a desirable indicator of environmental behavior when comparing with knowledge measurements. Also, numerous scales for this purpose have been published.

Thompson and Gasteiger (1985) investigated change in environmental attitude in Purdue University students between 1971 and 1981. The researchers found that the change was in

the direction of a more materialistic lifestyle with less consideration for environmental or energy issues. It also indicated that students' environmental attitudes were significantly associated with their sociodemographic backgrounds. Students showed less willingness to give up items and to conserve energy as family income level increased. Students from arts and science disciplines were more concerned about the environment than were students from other areas of study such as engineering, agriculture, life science, and human ecology. Students who were taking biology and sociology courses showed no difference in environmental concern when compared with those who were not taking such courses. Students from rural areas showed more willingness to give up material items and expressed more promise to energy conservation than those from urban areas.

Shetzer, Stackman, and Moore (1991) investigated environmental attitudes in a group of university business students. The researchers used the NEP Scale (Dunlap & Van Liere, 1978) and a self-constructed environmental attitude scale to tap the respondents' environmental concern. They found an overwhelming majority (96.6%) agreed that organizations should spend more money on environmental protection and that business leaders should take the lead in environmental protection efforts (74.3%). A majority also felt that organizations should have departments devoted specifically to environmental concerns (68.8%). A majority

clearly expressed that environmental concerns should not be less important than business profits (88.6%). A majority did not feel that people pay enough attention to environmental issues (75%). A majority also did not feel that government environmental regulations are too strict (72.4%). The research also indicated that students with better environmental attitudes showed a greater tendency to endorse the NEP worldview as shown by the correlation between the NEP and the general environmental attitude measurements ($r=.48$).

Using a 40-item attitude scale, Horsley (1984) compared American and non-American high school students' attitudes regarding issues of the physical environment. The non-American sample was comprised of students from foreign schools including those in Taiwan, Hong Kong, China, India, Swaziland, England, Nigeria, Kenya, and the Virgin Islands. The researcher concluded that American students rated the importance of environmental quality higher than foreign students. Whether this discrepancy remains at the college level deserves further investigation.

Studies Involving Environmental Behavior and Behavioral Intention

The majority of studies of environmental behavior measure behavioral intention rather than behavior. Also, the majority of research studies reporting actual environmental behavior were measured by self-report surveys. Very few studies reported direct observation of respondents'

overt behavior. Ajzen (1988) and Gray (1985) contended that self-reported behavioral measurement showed results similar to the measurement of behavior intent. Other researchers also argued that direct observation of overt behavior could result in under-reporting of the behavior.

Dunlap, Gale, and Rutherford (1973) investigated environmental concern and behavior in a sample of University of Oregon students. They found that college students expressed more environmental concern than environmental behavior and behavioral intention. Fifty percent of the respondents reported that they had taken action on at least one environmental issue. A majority of those who had participated in environmental activities indicated that the first actions in which they engaged were those that required neither expertise in terms of detailed knowledge of an issue, nor a sustained commitment. Of those who had taken actions, 27% indicated attending a rally or demonstration as their first action, and 25% mentioned signing letters or petitions. Other activities with less frequency were cleaning up an area (18%), speaking to groups (8%), organizing a campaign (5%), and picketing or sitting-in (3%). The students' past environmental actions were found to be strongly related to their environmental concerns. Students who scored high on an environmental concern scale were more likely to have taken environmental actions than those with low scores. Thirty-two percent of the sample

reported participation in at least one environmental organization on the university campus. To obtain an indication of students' intentions to employ stronger tactics than those traditionally used in environmental campaigns, the researchers asked students to respond to two hypothetical situations that were thought to be possible at the time (1970s) and the place (Oregon):

1. The Forest Service announces a timber sale in a previously uncut area that has many recreational values.

2. A large industry is polluting the air and tells an environmental agency that it is "economically unfeasible" to install pollution abatement equipment before 1975.

The students were asked what action, if any, they would be willing to take on each issue. Surprisingly, only 4% of the students said they would take no action, 19% indicated a willingness to resort to sit-ins to prevent the sale of timber in a recreational area, and 33% indicated a willingness to take similar action to prevent the continuance of industrial pollution. This willingness to take strong action was found to be highly correlated to students' concern for the environment. Only 9% of those with low scores on the environmental concern scale were willing to sit-in to protest the sale of timber by the Forest Service, while 28% of those with high scores said they would sit-in. Similarly, only 24% of the students scoring low on the concern scale indicated an intention to

sit-in to prevent an industry from delaying installation of pollution abatement equipment, while 43% of those with high scores expressed an intent to sit-in. In short, students' concern for the environment was found to be highly correlated to behavior and behavioral intention. The researchers concluded that college students, unlike most of the public, give strong support to environmental reforms even when such reforms challenge traditional priorities such as economic interests.

Bowman (1977) investigated environmental behavior intention in a sample of 325 students of University of Wyoming. When the students were asked, "In order that your own viewpoint on the environment and on growth be planned, which of the following methods of influencing decision makers would you approve? (P. 402)" The results indicated that more than 90% approved of writing letters to officials and 85% approved of attending meetings. Approximately 70% would contribute money for an educational campaign, support lawsuits, or work for political candidates. Forty-four percent endorsed rallies and demonstrations, 29% supported nonviolent modes of civil disobedience, and 8% approved of violent actions when other means fail.

Horsley (1977) studied the effect of "change-agent" and "role-playing" social learning on environmental behavior change. Ninety-six university students participated. A freshman class, "Geography of Man's Environment," was

divided into four groups using the Solomon four-group design technique. After a 20-day experiment period, it was found that students in the treatment groups scored significantly higher than the control group on their verbal environmental behavior measurement. Students in treatment groups were also observed to have more overt behavior than the control group.

Hine and Gifford (1991) examined environmental behavior in a group of 104 Canadian university students in an experimental study. Twelve percent of these students reported they had engaged in past activities. Students were informed about voluntarily participating in activities to help an environmental crisis concerning seashore water pollution. These activities included signing a petition and donating money and time to an environmental organization. Results showed more than 98% signed the petition. The average amount of money donated for the organization was \$1.99 (Canadian dollar) ($SD=4.55$). The average time the students promised to donate (expressed by signature on a form) was 2.67 hours ($SD=4.2$). Their verbal commitment was also evaluated on a scale. The average score was 5.86 (scale range: minimum=0, maximum=10).

Maloney and Ward (1973) compared a sample of college students' environmental and behavior intention with a noncollege sample and a Sierra Club sample. They found that college students expressed more behavioral intention and

behavior than noncollege subjects. However, the Sierra Club members outscored the two groups both in behavioral intention and behavior. Dispoto (1977) compared self-reported environmental behavior of a sample of college students and found that science students expressed more behavior than their humanistic counterparts. Gifford et al. (1983) determined environmental behavior and behavioral intention in a sample of Canadian college students. Their results indicated that academic majors did not affect environmental behavior and behavioral intention. They also found that females expressed more behavioral intention than males, but there was no difference in behavior.

Relationships Among Environmental Knowledge,
Attitudes, and Behavior

The development of environmentally responsible and active citizens has long been regarded as the ultimate goal of environmental education (Roth, 1970; Stapp, 1970; Jeske, 1978). Thinking in the field of environmental education traditionally has been that we can change behavior by making individuals knowledgeable about the environment and its associated issues. This thinking has been linked to the assumption that if we make individuals more knowledgeable, they will, in turn, become increasingly aware of the environment and its related problems and thus be more motivated to act toward the environment in more responsible ways. Such linkage has been stressed by some environmental educators. In clarifying the terms "belief," "attitudes,"

"values," and "behavior," Stapp (1974) cited Swan's (1974) statement that beliefs are cognitions, the cognitions of simple pieces of information about almost anything. By itself, belief has little relationship to behavior. Groups of beliefs, both cognitive and affective, may cluster toward a common object and collectively produce attitudes which represent a behavior predisposition toward that object. Groups of attitudes, in turn, cluster to form values, which in turn produce behavior. This statement clearly depicted their assumption of the relationships among knowledge, attitudes, behavioral intention, and behavior. This assumption also was supported by Stapp (1970) and can be seen in his definition of environmental education:

"Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution (p. 15)." Bennett (1974) also supported this assumption and added that an individual's feeling about and knowledge of the environment will form a tendency to act. The combination of knowledge, feeling, and tendency further help to form individual attitudes toward the environment. Bennett further reported that the relationships among environment, behavior, and attitudes are reciprocal. An individual may act toward his environment, and conditions in the environment might cause him to behave in certain ways.

On the other hand, an individual having a feeling or a knowledge of the environment or of its components may affect his attitudes, and knowledge or feelings possessed by other people in the environment may cause them to adopt attitudes or act in certain ways. Bennett (1989) recommended environmental program evaluation based on this theory. Although theories have been proposed, some researchers failed to prove such relationships among these variables, as shown by the following examples. Maloney and Ward (1973) failed to correlate environmental knowledge and environmental attitudes measures. Peyton and Hungerford (1980) indicated that the number of environment-related courses taken in college or high school did not affect perceived competence of environmental action. On the other hand, direct action involvement or learning by doing was positively correlated to competence of environmental behavior. The analysis by Hines et al. (1987) found that the correlation between attitude and behavior ($r=.347$, $SD=.224$) was lower than the correlation between verbal commitment (intention) and behavior ($R=.49$, $SD=.130$). On the contrary, Iwata (1982) found that college students' environmental behavior was related to environmental knowledge but not to environmental attitude.

The inconsistency as well as low correlations among environmental behavior and environmental attitude and knowledge have prompted researchers to search other

variables to explain environmental behavior as well as to seek alternative measures for the evaluation of educational programs.

Other Variables Influencing Environmental Behavior

Other variables that influence behavior have been noted by researchers (Wicker 1971; Ramsey & Rickson 1976; Trigg, Perlman, Perry, & Janisse, 1976). In the early 1970s, Wicker used three variables--perceived consequence of behavior, evaluation of behavior, and judged influence of external event on behavior--in addition to attitude to predict respondents' verbal and overt church behaviors. The researcher found that these variables significantly improved predictions of the behaviors. However, the researcher indicated that combining these "other variables" with the attitude variable could account for only approximately 25% of the variance, leaving 75% unexplained. Wicker encouraged behavioral researchers to further investigate variables such as social norms, habits, and ability (Wicker, 1971).

Sia, Hungford, and Tomera (1986) examined the relative contribution of eight variables in predicting responsible environmental behavior. The eight predictors are 1) level of sensitivity, 2) perceived knowledge of environmental action strategies, 3) perceived skill in using environmental action strategies, 4) psychological sex role classification, 5) individual locus of control, 6) group locus of control, 7) attitude toward pollution, and 8) belief in technology.

A stepwise regression analysis helped them to find that the first three of the eight variables studied were the best predictors of environmental behavior. Sia et al's finding was further confirmed by a recent study conducted by Sivek and Hungerford (1989).

Hines et al. (1987) performed a meta-analysis of 128 existing studies concerning environmental behavior. Fifteen variables were meta-analyzed to determine the strength of their association with environmental behavior. The result of the analysis indicated the following variables to be associated with responsible behavior: 1) knowledge of issues, 2) knowledge of action strategies, 3) locus of control, 4) attitudes, 5) verbal commitment, and 6) an individual's sense of responsibility.

In summary, research has provided neither a clear picture of the interrelationships among these variables and environmental behavior nor an indication of which variables are the best predictors of environmental behavior.

Studies of Environmental Behavior Models

Bennett (1974) developed a theoretical model to explain the relationships among behavior, environment, and attitudes for environmental education. The model stressed the importance of knowledge and affective components in environmental education. Bennett indicated that a human has basic psychological needs, and needs motivate an individual to adopt certain attitudes, which in turn satisfy his basic

needs. Attitudes consist of affective and cognitive components. The two components of attitudes may form a third component, a tendency to act. An individual's feelings or knowledge of the environment may affect his attitudes. In turn, an individual may act toward the environment, and conditions in the environment might cause him to behave in certain ways.

Another example of the environmental education model is Ramsey and Rickson's (1976) model. The model suggests that increased knowledge leads to favorable attitudes, which in turn lead to action promoting better environmental quality. Some researchers recommended the use of Fishbein's model and Traindis' model (Weigel, 1985; Gray, 1985). In recent years some new models have been developed. Based on the results of meta-analysis of existing studies, Hines et al. (1987) proposed a model similar to that of Fishbein. In the model, Hines et al. identified "intention to act" and "situational factors" as the primary-level variables responsible for environmental behavior. There were others variables classified as second- or third-level variables to influence behavior in the model. These variables included knowledge of issues, locus of control, knowledge of action strategies, attitudes, verbal commitment, and sense of responsibility. According to the suggestion of Hines et al., an individual who expresses an intention to take action will be more likely to engage in the action than will an individual who

expresses no such intention. However, it appears that intention to act is merely an artifact of a number of other variables acting in combination (e.g., cognitive knowledge, cognitive skills, and personality factors). Before an individual can intentionally act on a particular emotional problem, that individual must be cognizant of the existence of the issue. Thus, knowledge of an issue appears to be a prerequisite to action. An individual also must possess knowledge of those courses of action which are available and which will be most effective in a given situation. Another critical component is skill in appropriately applying this knowledge (e.g., knowledge of action strategies for a given issue). In addition, an individual must possess a desire to act. One's desire to act appears to be affected by a host of personality factors such as attitude toward the environment and toward the action, locus of control, and personal responsibility toward the environment. Situational factors such as economic constraints, social pressures, and opportunities to choose actions may serve to either counteract or to strengthen the other variables.

Hungerford and Volk (1990) synthesized the model of Hines et al. (1987) and a number of other recent research findings (Borden 1984-1985; Borden & Powell 1983; Koslowsky, Kluger, & Yinon, 1988; Ramsey 1989) and suggested another model. The model consists of three sets of variables related to environmental behavior. These are entry-level

variables, ownership variables, and empower variables. They hypothesized that these three categories of variables act on environmental behavior in a linear fashion. In the model, responsible environmental behavior can be predicted directly by "empowerment variables;" in turn, "empowerment variables" can be predicted by "ownership variables," and "ownership variables" can be predicted by "entry-level variables." In the model, "entry-level" variables include environmental sensitivity, knowledge of ecology, androgyny, and attitude toward pollution, technology, and economics. At the "ownership-level," the variables included are in-depth knowledge about issues, personal investment in issues related to the environment, knowledge of consequences of the behavior (both positive and negative), and a personal commitment to issue resolution. The empowerment component, the variable responsible for environmental behavior, includes the knowledge of skill in using environmental action strategies, locus of control, intention to act, and in-depth knowledge about issues.

The models of Hines et al. (1987) and Hungerford and Volk (1990) included attitude as a low-importance (third-level) variable in predicting behavior. Hungerford and Volk included knowledge about ecology in the entry level, but the Hines et al. model did not. Hines et al. focused more on knowledge of issues and action strategy rather than knowledge of the environment or ecology. Although a number

of new models concerning environmental behavior have been proposed, they are not yet fully developed. Furthermore, testing these newly proposed models requires reliable and valid instruments to be developed. It is more useful to reexamine traditionally studied variables using a comprehensive model in predicting environmental behavior.

The PRECEDE model (Green, Kreuter, Deeds, & Partridge, 1980; Green & Kreuter, 1991) has been widely applied in research dealing with health education; however, a review of literature indicated that this model has not received much attention by researchers in environmental education. Green and Kreuter indicated that no single behavior, or action, is caused by just a single factor, and any behavior can be explained as a function of the collective influence of three types of factors--predisposing, enabling, and reinforcing factors. Predisposing factors include a person's or population's knowledge, attitudes, beliefs, values, and perceptions that facilitate or hinder a behavior. Enabling factors are those skills, resources, or barriers that can help or hinder a behavior. Reinforcing factors are the rewards received by the person or feed-back from others following adoption of a behavior that may encourage or discourage continuation of the behavior. Environmental behavior can be influenced by a variety of variables; hence, it might be useful to apply the theory of the PRECEDE model in the study of environmental behavior.

Studies Assessing Preservice and Inservice
Teachers' Environmental Concerns

Studies concerning preservice or inservice teachers' environmental concerns were relatively few, and most focused on their attitude toward environmental education (Chu, 1990; Wong, 1991; Kou, 1987; Tsung, 1990; Wang & Tseng, 1991; Peyton & Hungerford, 1980; McCaw, 1980), perceived need of environmental education (Edralin, 1989; Simon, 1991), and perceived efficacy in teaching environmental education (Wang & Tseng, 1991; Chu, 1990; Tsung, 1990). Some studies examined knowledge (Buethe, 1975, 1985; Kou, 1987; Chu, 1990; Tsung, 1990, Wang & Tseng, 1991; Wong 1991). Some also dealt with teachers' attitudes toward the environment and its related issues (Buethe, 1975, 1985; Chu, 1990; Tsung, 1990; Wang & Tseng, 1991). Few mentioned teachers' personal environmental behavior measurement (Wang & Tseng, 1991; Peyton & Hungerford, 1980). No studies have been found to deal with preservice teachers' behavior, behavioral intention, attitudes, and knowledge.

Buethe (1975) investigated Indiana teachers' environmental knowledge and attitudes. The researcher indicated that teachers' general level of environmental knowledge and awareness was inadequate. The results also showed that a) science teachers had greater environmental knowledge than nonscience teachers, b) male teachers knew more about physical environment and environmental terms than female teachers, and c) older teachers were more

knowledgeable than younger teachers. Teachers expressed strong support for a clean environment. Buethe also asked teachers to self-grade their environmental knowledge and awareness. Results indicated that most teachers do not consider themselves highly informed with respect to environmental problems. Ten years later, Buethe (1985) conducted a similar study on the same population. The results of the two studies were very similar. However, Buethe indicated that teachers' environmental knowledge was much improved during the 10 years. The results also indicated that teachers' attitudes appear to have changed positively on most of the issues included in the studies. However, the researcher's final conclusions were a) teachers know too little, and they recognize that shortcoming, b) there appears to be a slight trend toward more realistic viewpoints of economic-environmental-energy interconnections.

Glass (1982) found that after a 30-week inservice training program, a group of elementary school teachers improved their environmental attitudes as well as their environmental knowledge. The change of attitudes and knowledge were maintained for at least one year after the training program.

Edralin (1989) investigated environmental attitudes in 347 preservice high school and middle school teachers in 16 selected colleges and universities in East Tennessee. A 45-

item questionnaire was used to assess the preservice teachers' attitudes toward air quality, water quality, land use, resource management, waste management, and over-population. Preservice teachers' environmental attitudes were compared item by item according to their demographic backgrounds, including gender, residence, academic major, and ethnic factors. The results indicated that a majority of the preservice teachers had strong opinions, feelings, and support for environmental quality. Their attitudes toward the environment varied depending on academic major and residence. Generally, preservice teachers expressed a higher degree of concern over problems about water and air quality.

Peyton and Hungerford's (1980) study found that colleges and high schools were the most common sources of environmental knowledge for preservice and inservice teachers. The researchers also indicated that most (80%) of the teachers reported not belonging to any environmental organization. Few of these preservice and inservice teachers reported participation in environmental activities such as helping to clean up an area, recycling trash, buying returnable bottles, or talking to friends about an issue. When their intention was asked, few of them expressed an intention to take an action such as writing letters or boycotting products.

McCaw (1980) surveyed 244 elementary teachers in Columbus, Ohio, to determine their attitudes toward environmental education. The results indicated no significant difference in environmental education attitudes among different demographic variables. However, most of the elementary female teachers expressed more concern on environmental education than did male teachers.

Chan, Su, Lin, Chiu, and Yu (1991) compared environmental knowledge and attitudes of 250 high school vocational teachers with their students and found that teachers were more knowledgeable about the environment but had a low level of environmental concern when compared with their students. Kou (1987) studied environmental knowledge in a sample of 280 senior and junior high schools teachers in Taiwan. The researcher used a self-developed 15-item knowledge scale to determine respondents' environmental knowledge. Scores of environmental knowledge of inservice teachers were compared according to their demographic backgrounds. The researcher concluded that science teachers have a better environmental knowledge than their counterparts in the humanics. Teachers' environmental knowledge was found to be significantly correlated with environmental sensitivity but not with environmental concern.

Tsung (1990) evaluated environmental knowledge of elementary teachers in three northern counties in Taiwan.

Elementary teachers had positive scores in "environmental awareness," "environmental attitudes," and "behavioral intention of environmental education," but they had poor scores in "knowledge" of the environment. Teachers' environmental concerns varied according to their sociodemographic backgrounds. The respondents' environmental knowledge score was significantly correlated to environmental attitudes measurement.

Chu (1990) evaluated a sample of junior high school teachers' environmental knowledge and attitudes. Teachers had low scores in environmental knowledge but showed positive attitudes toward the environment and environmental education. Teachers' environmental knowledge and attitudes were found to be different based on demographics such as sex, age, discipline, and teaching experience.

Wang and Tsung (1991) evaluated environmental knowledge and attitudes of current elementary school teachers in Taiwan. About 5,000 teachers from the main island as well as off-shore islands were included in the sample. The researchers indicated that teachers' environmental knowledge was affected by their educational background. Teachers trained in natural science areas were found to be more knowledgeable than their non-natural-science counterparts. Younger teachers (age under 45) were found to be more knowledgeable than their older counterparts (age 45 and over). Teachers' environmental knowledge showed

no differences based on the region of the school (north, middle, south, or east) in which they taught. However, those who taught on off-shore islands were found to have lower environmental knowledge than teachers on the main island. They also concluded that current elementary teachers' environmental knowledge was not sufficient. However, comparable group data to use for drawing any meaningful conclusions were unavailable. The researchers also indicated that teachers' attitudes toward local environment, environmental worldview, and behavior varied according to their sex, age, and school locations. Furthermore, environmental behavior was found to be correlated with environmental worldview and attitude toward local environmental problems. However, no significant relationship was found between behavior and knowledge.

Using a self-constructed questionnaire, Wong (1991) determined preservice elementary teachers' knowledge concerning environment. She found that males showed better environmental knowledge than females. Students from urban areas had higher environmental knowledge than their rural counterparts, although this was not statistically significant. Students who had previously enrolled in environment-related courses or participated in extracurricular activities concerning environmental education showed higher environmental knowledge than those who did not. Also, the researcher found that freshmen were

more knowledgeable in environmental issues than their junior counterparts. Again, the researcher concluded that the students' environmental knowledge was inadequate as demonstrated by overall low scores on the scale (58%).

Summary

This chapter reviewed 1) environmental education and its related issues, 2) instruments used to measure environmental concerns, 3) factors influencing environmental concerns, 4) relationships among environmental behavior, attitudes, and knowledge, 4) assessment of inservice/preservice teachers' environmental concerns.

The review is summarized as follows:

1. Environmental education evolved as a field in late 1960s and grew rapidly in 1970s. In recent years its progress seems to be leveling off. The barriers to its growth and development are related to its interdisciplinary and multidisciplinary nature. Broad definitions of environmental education and inconsistency in goal setting have caused difficulty in curricula development, implementation, and evaluation. Environmental education is a life-long education. The Environmental Education Act encouraged the implementation of environmental education across all disciplines and all grade levels. Major constraints to development, implementation, and evaluation have been indicated as a) educational material is increasingly organized around disciplines, and little

emphasis is placed on problem solving; b) curricula are already crowded with subject matter and hence it is difficult to persuade administrators to incorporate additional areas of study into the school day; c) environmental education cannot avoid value questions; and d) there is a severe shortage of classroom teachers prepared to effectively integrate environmental education into instructional programs. Results from studies concerning effects of inservice training or related activities for current teachers seem to be encouraging. However, many questions need to be resolved in regard to the time and place for training and teachers' willingness to participate. A fundamental approach to environmental education is the development of effective curricula for preservice teachers.

2. There are several types of measurement for environmental concerns, such as single component measures and multicomponent measures. The method of measurement can be divided into single items measurement and multiple items (scale) measurement. Single items measurement usually has less reliability.

3. A low correlation between environmental behavior and attitude has been a problem in the research of environmental behavior. Some researchers proposed to improve attitude-behavior correspondence or to increase attitude-object specificity for increasing the correlation between the two measures. Others recommended broadening the behavior scope

to increase attitude-behavior correspondence. Also, some researchers argued that broadening the behavior scope would cancel the magnitude of relationship, i.e., may decrease the level of correlation.

4. Due to the low or inconsistent correlation between attitude and behavior, a number of researchers have been studying other variables that may influence environmental behavior and developing new models for the improvement of environmental education.

5. Traditional environmental behavior models seem simple in explaining or predicting environmental behavior. Development of new models are underway, and further studies are needed. Other models commonly applied in health behavior such as Fishbein and Ajzen's (1975) reasoned action, social learning, and perceived threatening have been tried or recommended for adoption in environmental behavioral research. Green and Kreuter's (1991) PRECEDE model for diagnosing health behavior has the potential for revealing the relationships between environmental behavior and a wide range of predisposing and sociodemographic factors.

6. There were few studies that examined environmental knowledge, attitudes, and behavior of current teachers or preservice teachers, and the findings were inconsistent. Teachers' environmental knowledge, attitudes, and behavior deserve further examination in order to establish baseline

data for educational intervention. Due to instrument problems and other reasons, it has been difficult for comparisons among various studies. Environmental problems are global issues, and it is important to use the same valid instruments to gauge respondents' environmental concerns in order to facilitate cross-cultural comparisons.

CHAPTER III METHODOLOGY

The purpose of this study was to examine the environmental knowledge, attitudes, and behavior of preservice elementary teachers in Taiwan, Republic of China. A related purpose was to investigate the relationships among environmental behavior and related predisposing and sociodemographic factors. An additional purpose was to predict environmental knowledge, attitudes, behavior intention, and behavior from predisposing and sociodemographic variables. This section contains 1) subjects, 2) sampling procedure and data collection, 3) instrumentation, 4) specification of variables, and 5) analysis of data.

Subjects

Subjects for this study were the students in the nine teachers colleges in Taiwan. A total of 493 second-year students participated in the study. The sample was comprised of 239 males and 254 females with an average age of 20.94 ($SD=1.45$). Teachers colleges in Taiwan are four-year training institutions funded by the government. Each teachers college offers four major areas of academic programs: elementary education, language education, social studies, and mathematics and science education. Students enrolled in these colleges were selected based on the

results of their National Joint Entrance Examination for Universities and Colleges. Subjects in the study were randomly selected from a stratified sample of all second-year students enrolled during spring semester, 1992. The breakdown of the subjects according to their disciplines and regions is presented in Table 1.

Sampling Procedure and Data Collection

The sampling procedure used in the study was a stratified random sampling (Smith & Glass, 1987). The subjects were selected by the following procedure.

First, the nine teachers colleges were stratified into four regions according to their geographical location on the island of Taiwan. By this stratification, the north region, middle region, east region, and south region included 3, 2, 2, and 2 teachers colleges, respectively.

The reason for this stratification was the degree of urbanization within the four regions is different. The north region of Taiwan is the most developed area, followed by the middle, the south, and the east regions. Although the east region is the least developed area in Taiwan, it was noted that the two colleges are located in populated cities in the region. This stratification procedure enhanced student representation from each region.

Second, within each region, the students were further stratified into four categories according to their academic disciplines--elementary education, language education,

social studies, and mathematics and science education. Each teachers college enrolls up to three classes at each grade level for each discipline.

Third, for each discipline in each region, one class (25-36 students) was randomly selected for the study. The purpose of such stratification was to insure students in each area of discipline were well represented. Based on this sampling procedure, a total of 16 classes were selected. Composition of subjects according to region and academic discipline is presented in Table 1. After comparison, the subjects were found to be representative with second-year and total teachers college students on the variables of sex and academic discipline. After selection of the subjects, professors of each of the sampled classes were contacted by telephone to get permission to use classroom time for survey administration. In order to be consistent, the researcher administrated all surveys under the assistance of the professor who was responsible for the class at the time of the survey. It took 20 to 25 minutes for subjects to complete the survey.

Instrumentation

A survey consisting of an environmental knowledge scale, two environmental attitude scales, a behavior intention scale, an environmental behavior scale, and a number of questions concerning student's sociodemographic status was used to collect data. Information concerning

Table 1. Number of Subjects According to Region and Academic Discipline

Academic Major Region	Total Class	Class Samp.	Students Samp.	Students Attend.	Valid Survey
Elementary Education					
North	7	1	35	30	30
Middle	6	1	36	34	33
East	3	1	31	29	29
South	6	1	36	34	34
Language Education					
North	3	1	35	35	34
Middle	2	1	33	32	31
East	2	1	30	28	28
South	2	1	34	30	29
Social Studies					
North	3	1	29	26	26
Middle	2	1	33	33	30
East	2	1	32	29	29
South	2	1	35	31	31
Mathematics and Science					
North	5	1	36	34	34
Middle	3	1	36	34	33
East	2	1	33	28	28
South	3	1	34	30	29
Total	63	16	538	497	493

what is measured and the reliability and validity of each instrument is presented.

Environmental Knowledge Scale

The Environmental Knowledge Scale used in this study was Maloney's Knowledge Scale (Maloney, Ward, & Braucht, 1975). The scale contains 15 five-response multiple choice items with one correct answer. One item (item 12) in the original scale was modified in order to fit the local conditions for the study. In the original scale, item 12 asked, " Which of the following well-known groups is primarily interested in conservation issues? A) Boy Scouts of American, B) The Sierra Club, C) Kiwanis, D) 4-H Club, E) The Ecology Association." The item was maintained, but responses were reworded as "A) 4-H Club, B) The Green Peace Revolution Organization, C) Boy Scouts of China, D) The Consumers' Association, E) The Bird Watching Club." Response B is the correct answer.

The validity and reliability of the scale had been reported by the researchers (Maloney et al., 1975). The Pearson coefficient of the scale was .89. Using Spearman-Brown formula, Dispoto (1977) also found the reliability coefficient of the scale was high ($\alpha=.84$). The 15-item scale is included in the Appendix.

Environmental Worldview Scale

The New Environmental Paradigm (NEP) Scale was used to measure subjects' environmental worldview (Dunlap & Van

Liere, 1978). The scale contains 12 items and is designed to measure environmental attitudes in four conceptual dimensions, "limits to growth," "balance of nature," "steady-state economy," and "space earth" (Dunlap & Van Liere, 1978; Catton & Dunlap, 1980). Eight of the 12 items were worded such that agreement reflected acceptance of the NEP; for the other four items (3, 4, 6, and 10), disagreement reflected acceptance of the NEP. Scores for the pro-NEP items were determined based on responses to the question, e.g., 4 for "Strongly Agree," 3 for "Mildly Agree," 2 for "Mildly Disagree," and 1 for "Strongly Disagree." The scoring for the four anti-NEP items (3, 4, 6, and 10) was reversed. Subjects scored high on the scale, indicating they have greater environmental concern.

The reliability and validity of the NEP Scale had been reported by the developers (Dunlap & Van Liere, 1978). The Cronbach's α was .813 for the general public sample (GPS) and .758 for the environmental organization sample (EOS). The Omega coefficient was .849 for GPS and .802 for EOS. The validity and reliability of the NEP Scale also had been reported by the developers and further validated by other researchers (Geller & Lasley, 1985). All 12 items in the NEP Scale were adopted without modification. The 12-item scale is included in the Appendix.

Environmental Attitude Scale

The Weigel's Environmental Concern Scale was adopted in this study to measure the subjects' environmental attitudes toward pollution and conservation (Weigel & Weigel, 1978). The scale consists of 16 statements. Seven (1, 3, 6, 7, 15, and 16) of the statements are positively stated, and nine (2, 4, 5, 8, 9, 11, 12, 13, and 14) are negatively stated. Subjects were asked to rate each item along a five-point Likert scale ranging from "strongly agree" to "strongly disagree." Each item was scored 0-4, yielding a scale score ranging from 0-64, with high scores indicating very strong concern about environmental issues. The reliability and validity of the scale had been reported by the researchers. The Cronbach's α of the scale was .88. Scott's homogeneity ratio (HR) of the scale was .26, and item-scale criterion correlation was .58. The developers indicated that six years after the first survey in 1970, using a different sample resulted in an α =.85 and HR=.26. A six-week test-retest correlation was r =.83, (P <.001). The validity of the scale using known-groups comparison is Chi-square, 77.32 (P <.001). The attitude behavior correlation coefficient was .62.

All items in the scale were adopted without modification except item 16. Item 16, "I would be willing to accept an increase in my family's expenses of 100 dollars next year to promote the wise use of natural resources."

The dollar amount asked in the stem was modified to reflect the appropriate currency and the local economic condition of the subjects. The 16-item scale is included in the Appendix.

Environmental Behavioral Intention Scale

The Verbal Commitment Scale (Maloney & Ward, 1973; Maloney et al., 1975) was adopted for this study to measure students' environmental intent. The scale contains 10 items to measure subjects' concern in regard to environmental pollution and conservation. The items are presented in a true-false format. To control for acquiescence and negative sets, items 1, 3, 6, 7, and 8 were worded in a positive manner and others in a negative manner. One example of the items is, "I would be willing to ride a bicycle or take bus in order to reduce air pollution." The reliability and validity of the scale as had been reported by the developers and further validated by Disposito (1977) is .813. The Pearson coefficient for the scale is .91. The 10-item scale is included in the Appendix.

Environmental Behavior Scale

The 11 items in the Environmental Scale were adopted from the Environmental Behavior Inventory developed by Mortonson (1978). This instrument was intended to assess environmental behavior concerning pollution and conservation. Both the validity and reliability had been reported by the developer. The validity was determined by a

panel of experts. The reliability was tested using a one-week test-retest procedure ($r=.70$). The scale was further validated by the researcher ($r=.68$). The 11-item scale is included in the Appendix.

Sociodemographic Variables

Ten questions concerning preservice elementary teachers' sociodemographic status were incorporated into the survey. Table 2 is a summary of these sociodemographic variables. Item 1 asked subject's age, item 2 asked gender, item 3 asked academic discipline, and item 4 asked academic concentration area in senior high school. In Taiwan, all senior high school students are required to select one of the two academic concentration areas (social science and nature science) at the beginning of the second year in high school. Item 5 asked subject's past residence. Four responses were provided: 1) national city, 2) provincial city, 3) city at the county level, and 4) township and rural area. This classification was based on the population size of the residence area. A national city had a population equal or larger than 1 million. A provincial city had a population between .2 to 1 million. A county level city had a population between .15 to .2 million, and the population size of a township or rural area was less than .15 million. Item 6 assessed subject's family economic condition by asking, "Generally, my family economic condition is 1) Excellent, 2) Good, 3) Just OK, 4) Poor." Item 7 asked

subjects about their parents' jobs, "The person who has the most responsibility for my family income is a 1) Laborer, 2) Farmer, 3) Businessman, 4) Teacher, 5) Private organization employee, 6) Government employee, 7) Policeman or military personnel, 8) Other (Please specify) _____. Items 6 and 7 served as indicators of subjects' socioeconomic status. Item 8 asked, "Have you taken any environmental education or environmental science courses? 1) Yes, 2) No, 3) Currently taking." Item 9 asked, "Which of the following subject areas do you like most? 1) Language and literature, 2) Social sciences, 3) Art, music, and other skills, 4) Mathematics, 5) Physics and chemistry, 6) Biological sciences, 7) Others (Please specify) _____. Item 10 asked subject's self-identified political ideology. The question asked, "My political ideology is in favor of 1) the current ruling party, 2) the main opposition party, 3) no political ideology, 4) others (Please specify) _____."

Translation and Pilot Test of the Questionnaire

All items included in the survey were translated into Chinese by the researcher. The translation was then validated by a Chinese-American professor and three Ph.D. students in related areas (one from education and two from environmental science). Twenty-eight University of Florida Chinese graduate students were used to pilot test the survey. Further modifications were made after the pilot test.

Classification of Variables

According to Green and Kreuter's (1991) theory, the variables concerning environmental knowledge, general environmental attitude, environmental worldview, and environmental behavioral intention were identified as predisposing factors. However, the 10 sociodemographic variables were not further classified into enabling or reinforcing factors according to Green and Kreuter's classification; rather, they were combined as sociodemographic variables in this study. This classification was designed to test the theory that predisposing, enabling, and reinforcing factors may be useful in diagnosing environmental behavior.

Analysis of Data

Data collected were analyzed by two procedures using the statistical package SPSS/PC+ (1991). Descriptive data of the study were analyzed and presented as means and standard deviations or frequencies and percentages. Data related to the relationships among variables were analyzed by correlation and multiple regression. A zero-order correlation analysis was performed to examine relationships among environmental behavior, environmental behavioral intention, environmental attitudes, and environmental knowledge. The combined scores of various scales in the study were used for this analysis. Multiple regression analysis was used to determine the relationships between

environmental behavior and the predisposing variables, as well as the sociodemographic variables. In the equation, behavior was treated as a criterion variable, and predisposing variables (behavioral intention, attitudes, and knowledge) and sociodemographic variables (age, gender, academic discipline, senior high school course concentration, residence, region of college location, economic condition, parental job, and political ideology) were entered simultaneously as predictors. A second multiple regression analysis was performed using environmental behavior intention as the criterion variable; predisposing variables and sociodemographic variables were simultaneously entered as predictors. A third multiple regression analysis used the environmental attitude score measured by the Weigel's Ecological Concern Scale as the criterion variable, and the knowledge variable and sociodemographic variables were entered as predictors. A fourth multiple regression analysis used the environmental worldview score measured by the NEP (Dunlap & Van Liere, 1978) as the criterion variable, and the knowledge variable and demographic variables were entered as predictors. A fifth regression analysis was performed using environmental knowledge as the criterion variable and sociodemographic variables as predictors. All tests used $p \leq .05$ as the significant value for rejection of a null hypothesis.

CHAPTER IV RESULTS AND DISCUSSION .

Results

The purpose of this study was to examine the environmental knowledge, attitudes, and behavior of preservice elementary teachers in Taiwan, Republic of China. Related purposes were to examine the interrelationships among environmental behavior, behavioral intention, attitudes, and knowledge, and to explore whether environmental concerns can be predicted from predisposing and sociodemographic variables.

Sociodemographic Distribution of Subjects

A total of 493 students in 16 second-year teaching classes from the four discipline areas of the nine teachers colleges in four geographical regions in Taiwan were selected for the present study (Table 2). Ages of the students in the sample ranged from 19 to 27. The sample consisted of 26.6% of the second-year student population (N=1857). The second-year student population consisted of 26.0% of the entire student population of the teachers colleges (N=7143). The proportion of the males (48.5%) and females (51.5%) of the sample was similar to that of the second-year student population (male, 48.6%; female, 51.4%), as well as the total student population of all teachers

Table 2. Frequencies and Percentages of Sociodemographic Variables

Variable	Frequency	Percent
GENDER		
Male	239	48.5
Female	254	51.5
	-----	-----
TOTAL	493	100.0
CURRENT ACADEMIC MAJOR		
Elementary education	126	25.6
Language education	122	24.7
Social studies	116	23.5
Math. and science	129	26.2
	-----	-----
TOTAL	493	100.0
REGION OF COLLEGE		
North	124	25.2
Middle	129	26.2
East	114	23.1
South	126	25.6
	-----	-----
TOTAL	493	100.0
RESIDENCE (Population in millions)		
National city (over 1 M)	78	15.8
Provincial city (0.2 - 1 M)	64	13.0
County city (.15 - .2 M)	92	18.7
Town and rural (under .15 M)	259	52.5
	-----	-----
TOTAL	493	100.0
ENVIRONMENTAL EDUCATION EXPERIENCE		
Have taken	62	12.6
Not yet	419	85.0
Currently taking	12	2.4
	-----	-----
TOTAL	493	100.0
HIGH SCHOOL COURSE CONCENTRATION		
Social Science	340	69.0
Natural Science	153	31.0
	-----	-----
TOTAL	493	100.0

Table 2. Cont'd.

STUDY INTEREST		
Social sciences	234	47.5
Natural sciences	148	30.0
Art, music, and skills	111	22.5
	-----	-----
TOTAL	493	100.0
ECONOMIC CONDITION		
Excellent	3	.6
Good	386	78.3
Just OK	101	20.5
Poor	3	.6
	-----	-----
TOTAL	493	100.0
PARENTAL JOB		
Labor		159
32.3		
Farmer	82	16.6
Businessman	94	19.1
White collar	147	29.8
Military and policeman	11	2.2
	-----	-----
TOTAL	493	100.0
POLITICAL IDEOLOGY		
Pro-current ruling party	146	29.6
Pro-opposition party	29	5.9
No political ideology	318	64.5
	-----	-----
TOTAL	493	100.0
AGE (Years)		
19	45	9.1
20	191	38.7
21	126	25.6
22	71	14.4
23	32	6.5
24	7	1.4
25	10	2.0
26	9	1.8
27	2	.4
	-----	-----
TOTAL	493	100.0

colleges (male, 48.2%; female, 51.4%). The number of sampled students in the academic major areas of elementary education, language education, social studies, and mathematics and science education was 126 (25.6%), 122 (24.7%), 116 (23.5%), and 129 (26.1%), respectively. The number of students sampled from the northern, middle, eastern, and southern regions was 124 (25.2%), 129 (26.2%), 114 (23.1%), and 126 (25.6%), respectively. Table 2 summarizes the frequencies and percentages of sociodemographic distribution.

Preservice Elementary Teachers' Environmental Knowledge, Worldview, Attitudes, Behavioral Intention, and Behavior

Research question 1 asked, "What were the environmental knowledge, worldview, attitudes, behavioral intention, and behavior of the preservice elementary teachers?" The preservice elementary teachers' environmental knowledge was measured by a scale adopted from the Environmental Knowledge Scale (Maloney et al., 1975). Environmental attitude was assessed by two measures: the Ecological Concern Scale (Weigel & Weigel, 1978) and the NEP Scale (Dunlap & Van Liere, 1978). Environmental behavioral intention was measured by the Environmental Verbal Commitment Scale (Maloney et al., 1975). Environmental behavior was measured by the 11-item Environmental Behavior Scale from Mortonson's (1978) Environmental Behavior Inventory.

Environmental knowledge

Results of preservice elementary teachers' environmental knowledge are summarized in Table 3. The scale contains 15 items. For the purpose of data analysis, subjects' responses were recorded with 1 as correct and 0 as incorrect. The scale has a possible range of 0 to 15. As can be seen in Table 3, the mean score of the Environmental Knowledge Scale for the sampled subjects was 9.33 (S.D.=1.96). Environmental knowledge score was 9.26 (SD=2.11) for males and 9.40 (SD=1.80) for females. Scores for the elementary education majors were 9.17 (SD=1.68), for language education majors, 9.06 (SD=1.68), for social studies majors, 9.55 (SD=1.87), and for mathematics and science education majors, 9.55 (SD=2.03). Scores according to region of college location were north, 9.77 (SD=1.62); middle, 9.40 (SD=1.71); east, 8.68 (SD=2.44); and south, 9.41 (SD=1.90). Scores according to place of residence were national cities, 9.32 (SD=2.27); provincial cities, 8.78 (SD=2.44); county-level cities, 9.67 (SD=2.44); and town and rural, 9.41 (SD=1.90). Those who chose social science as their high school course concentration had a mean score of 9.26 (SD=1.92), and those who chose natural science as their high school course concentration had a score of 9.49 (SD=2.03). Scores according to subjects' experience in taking an environment-related course(s) were those who had taken, 9.37 (SD=1.93); those who had not, 9.34 (SD=1.95);

Table 3. Mean Scores for Environmental Knowledge, Worldview, Attitude, Behavioral Intention, and Behavior for Different Categories

Variable	Knowledge		Worldview		Attitude		Intention		Behavior	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TOTAL	9.33	1.96	39.14	4.52	47.83	5.37	6.56	1.90	27.67	3.34
SEX										
Male	9.26	2.11	38.86	5.09	47.39	6.10	6.43	1.98	27.46	3.35
Female	9.40	1.80	39.40	3.91	48.24	4.56	6.69	1.84	27.86	2.98
DISCIPLINE										
Ele. Ed.	9.17	1.68	39.29	4.26	47.86	5.33	6.31	1.97	27.63	2.79
Lan. Ed.	9.06	1.68	38.86	4.56	47.80	5.91	6.93	1.68	27.96	2.67
Soc. Ed.	9.55	1.87	39.91	4.58	48.20	4.93	6.53	1.92	27.59	3.05
Sci. Ed.	9.55	2.03	38.53	4.62	47.48	5.32	6.50	2.00	27.79	3.34
REGION										
North	9.77	1.62	38.45	4.36	48.75	4.66	6.90	1.86	27.91	2.92
Middle	9.40	1.71	39.71	4.17	47.79	5.10	6.43	1.96	27.47	2.84
East	8.68	2.44	38.75	5.13	46.59	6.34	6.78	1.83	28.05	2.88
South	9.41	1.90	39.57	4.36	48.07	5.21	6.55	1.92	27.29	3.23
RESIDENCE										
Nat. Ct.	9.32	2.27	39.65	4.42	48.29	6.30	6.67	1.82	28.69	2.74
Prov. Ct.	8.78	2.16	39.39	6.02	47.88	6.01	6.69	1.82	27.72	2.75
County Ct.	9.67	1.53	39.41	4.00	47.75	5.00	6.33	1.98	27.48	3.39
Rural	9.35	1.92	38.82	4.29	47.70	5.05	6.59	1.93	27.42	2.90
HIGH SCHOOL COURSE CONCENTRATION										
Soci. Sc.	9.26	1.92	39.29	4.51	47.94	5.38	6.59	1.87	27.60	2.80
Natu. Sc.	9.49	2.03	38.81	4.55	47.58	5.37	6.50	2.00	27.82	3.35
ECONOMIC										
Excellent	6.67	3.21	37.00	9.64	45.33	7.51	6.00	1.73	28.00	1.00
Good	9.30	2.00	39.17	4.57	48.08	5.37	6.61	1.91	27.61	2.82
Ok	9.63	1.64	39.03	4.19	47.24	4.87	6.51	1.81	28.03	3.45
Poor	6.67	2.08	40.33	4.16	38.00	9.97	6.00	1.57	22.00	1.00
PARENTAL JOB										
Labor	9.40	2.03	39.28	4.73	48.08	5.20	6.64	1.84	27.86	3.13
Farmer	9.35	1.93	39.22	4.35	48.05	4.99	6.58	2.02	27.67	3.25
Business	9.53	1.82	39.35	4.26	46.77	5.79	6.41	1.96	27.23	2.58
W. collar	9.09	2.02	38.91	4.48	48.00	5.12	6.52	1.88	27.73	2.92
Mil & Pol.	9.73	1.20	37.73	5.72	49.18	4.83	7.09	2.17	27.82	2.96

Table 3. Cont'd.

ENVIRONMENTAL EDUCATIONAL EXPERIENCE

Have taken	9.37	1.93	39.06	4.76	47.74	5.96	6.61	1.68	28.42	2.78
Haven't	9.34	1.95	39.15	4.44	47.82	5.24	6.56	1.94	27.52	3.01
Taking	9.00	2.66	39.17	6.31	48.50	7.05	6.42	2.11	29.08	1.68

STUDY INTEREST

Soc. sci.	9.41	1.97	39.30	4.41	48.11	4.87	6.56	1.88	27.71	2.87
Nat. sci.	9.53	1.79	38.91	4.52	47.15	5.28	6.48	2.04	27.63	3.25
Art, etc.	8.79	2.11	39.05	4.84	47.93	6.68	6.71	1.78	27.60	2.85

POLITICAL IDEOLOGY

Ruling	9.48	2.06	38.86	4.72	47.43	5.40	5.86	2.28	27.43	3.01
Opposit.	8.86	2.70	38.66	5.76	48.14	8.48	5.59	2.28	27.93	3.83
Non-ideo.	9.31	1.83	39.31	4.03	47.98	5.00	6.63	1.87	27.75	2.89

Range of Scores

1. Environmental knowledge: minimum=.00, maximum=14.00 (scale range: 0-15)
2. Environmental worldview: minimum=21.00, maximum=48.00 (scale range: 12-48)
3. Environmental attitude: minimum=22.00, maximum=62.00 (scale range: 0-64)
4. Environmental behavioral intention: minimum=.00, maximum=10.00 (scale range: 0-10)
5. Environmental behavior: minimum=20.00, maximum=41.00 (scale range: 11-44)

and those who were currently taking, 9.00 (SD=2.66). Environmental knowledge scores according to parental job were labor, 9.40 (SD=2.03); farmer, 9.35 (SD=1.93); businessman, 9.53 (SD=1.82); white collar, 9.09 (SD=2.02); and military and police, 9.73 (SD=1.20). Scores according to family economic condition were excellent, 6.67 (SD=3.21); good, 9.30 (SD=2.00); just ok, 9.63 (SD=1.64); and poor, 6.67 (SD=2.08). Environmental knowledge scores according to study interest were social sciences, 9.41 (SD=1.97); natural sciences, 9.53 (SD=1.79); and art and other skill subjects, 8.79 (SD=2.11). Scores according to political ideology were pro-ruling party, 9.48 (SD=2.06); pro-opposition party, 8.86 (SD=2.70); and no political ideology, 9.31 (SD=1.83).

Environmental worldview

Environmental worldview of preservice elementary teachers was measured by the NEP Scale (Dunlap et al.). The results of the NEP Scale measure are summarized in Table 3. As can be seen, the mean scores of the NEP Scale for all subjects were 39.14 (S.D.=4.52); for males, 38.86 (SD=5.09); and for females, 39.40 (SD=3.91). Scores according to subjects' academic disciplines were elementary education, 39.29 (SD=4.26); language education, 38.86 (SD=4.56); social studies, 39.91 (SD=4.58); and mathematics and science, 38.53 (SD=4.62). The NEP scores according to region of selected colleges were north, 38.45 (SD=4.56); middle, 39.71 (SD=4.17); east, 38.75 (SD=5.13); and south, 39.57

(SD=4.36). Scores according to residence were national cities, 39.65 (SD=4.42); provincial cities, 39.39 (SD=6.02); county-level cities, 39.41 (SD=4.00); and town and rural, 38.82 (SD=4.29). Scores according to high school course concentration were social science, 39.29 (SD=4.51), and natural science, 38.81 (SD=4.5). Scores according to family economic condition were excellent, 37.00 (SD=9.64); good, 39.17 (SD=4.57); just ok, 39.03 (SD=4.19); and poor, 40.33 (SD=4.16). Scores according to parental job were labor, 39.28 (SD=4.73); farmer, 39.22 (SD=4.35); businessman, 39.35 (SD=4.26); white collar, 38.91 (SD=4.48); and military and police, 37.73 (SD=5.72). Scores according to experience in taking environment-related courses were those who have taken related course(s), 39.06 (SD=4.76); those who have not, 39.15 (SD=4.44); and those who were currently taking, 39.17 (SD=6.13). Scores according to study interest were social sciences, 39.30 (SD=4.41); natural sciences, 38.91 (SD=4.52); and art and other skills, 39.05 (SD=4.84). Scores according to political ideology were pro-ruling party, 38.86 (SD=4.72); pro-opposition party, 38.66 (SD=5.76); and no political ideology, 39.31 (SD=4.03).

Environmental attitudes

The preservice elementary teachers' environmental attitudes toward pollution and conservation were measured by using the scale adopted from the Environmental Concern Scale (Weigel & Weigel, 1978). The results are summarized in

Table 3. The mean score for the total sample was 47.83, and the standard deviation was 5.38. Score for males was 47.39 (SD=6.10), and for females, 48.24 (SD=4.56). Scores according to academic disciplines were elementary education, 47.86 (SD=5.33); language education, 47.80 (SD=5.91); social studies, 48.20 (SD=4.93); and mathematics and science education, 47.48 (SD=5.32). Scores according to region of college location were north, 48.75 (SD=4.36); middle, 47.79 (SD=5.10); east, 46.59 (SD=6.34); and south, 48.07 (SD=5.21). Scores according to subject's residence were national city, 48.29 (SD=6.30); provincial city, 47.88 (SD=6.01); county-level city, 47.75 (SD=5.00); and town and rural, 47.70 (SD=5.05). Scores according to high school course concentration were social science, 47.94 (SD=5.38) and natural science, 47.58 (SD=5.37). Scores according to family economic condition were excellent, 45.33 (SD=7.51); good, 48.08 (SD=5.37); just ok, 47.24 (SD=4.87); and poor, 38.00 (SD=9.97). Scores according to parental job were labor, 48.08 (SD=5.20); farmer, 48.05 (SD=4.99); white collar 48.00 (SD=5.12); businessman, 46.77 (SD=5.79); and military and police, 49.18 (SD=4.83). Scores according to experience in environmental education were those who have taken related course(s), 47.74 (SD=5.96); those who have not, 47.82 (SD=5.24); and those who were currently taking a course, 48.50 (SD=7.05). Scores according to study interest were social sciences, 48.11 (SD=4.87); natural sciences,

47.15 (SD=5.28); and art, music, and other skill subjects, 47.93 (SD=6.68). Scores according to political ideology were pro-ruling party, 47.43 (SD=5.40); pro-opposition party, 48.14 (SD=8.48); and no political ideology, 47.98 (SD=5.00).

Environmental behavioral intention

The preservice elementary teachers' environmental behavioral intention was measured by the Environmental Behavioral Intention Scale. Table 3 summarizes the means and standards for the total sample and for each category. Mean scores for the total sample were 6.56 (SD=1.91), for males, 6.43 (SD=1.98), and for females, 6.69 (SD=1.84). Scores according to academic disciplines were elementary education, 6.31 (SD=1.97), language education, 6.93 (SD=1.68), social studies, 6.53 (SD=1.92), and mathematics and science, 6.50 (SD=2.00). Scores according to region of colleges were north, 6.90 (SD=1.86); middle, 6.43 (SD=1.96); east, 6.78 (SD=1.83); and south, 6.55 (SD=1.92). Scores according to residence were national cities, 6.67 (SD=1.82); provincial cities, 6.69 (SD=1.82); county-level cities, 6.33 (SD=1.98); and town and rural, 6.59 (SD=1.93). Scores according to high school course concentration were social science, 6.59 (SD=1.87) and natural science, 6.50 (SD=2.00). Scores according to family economic condition were excellent, 6.00 (SD=1.73); good, 6.61 (SD=1.91); just ok, 6.51 (SD=1.81); and poor, 6.00 (SD=1.57). Scores according

to parental job were labor, 6.64 (SD=1.84); farmer, 6.58 (SD=2.02); businessman, 6.41 (SD=1.96); white collar, 6.52 (SD=1.88); and military and police, 7.09 (SD=2.17). Scores according to experience in environmental education were those who have taken related course(s), 6.61 (SD=1.68); those who have not, 6.56 (SD=1.94); and those who were currently taking a course, 6.42 (SD=2.11). Scores according to study interest were social sciences, 6.56 (SD=1.88); natural sciences, 6.48 (SD=2.04); and art and other skills, 6.71 (SD=1.78). Scores according to political ideology were pro-ruling party, 5.86 (SD=2.28); pro-opposition party, 5.59 (SD=2.28); and no political ideology, 6.63 (SD=1.87).

Environmental behavior

The preservice elementary teachers' environmental behavior was measured by the Environmental Behavior Scale. Table 3 shows the means and standard deviations of environmental behavior for various groups. The mean score of the preservice elementary teachers was 27.67 and the standard deviation was 2.98. Score for males was 27.46 (SD=3.35), and for females, 27.86 (SD=2.98). Scores according to academic disciplines were elementary education, 27.63 (SD=2.97), language education, 27.96 (SD=2.67), social studies, 27.59 (SD=3.05), mathematics and science education, 27.79 (SD=3.34). Environmental behavior scores according to region of college location were north, 27.91 (SD=2.72); middle, 27.47 (SD=2.84); east, 28.05 (SD=2.88); and south,

27.29 (SD=3.23). Scores according to residence were national cities, 28.69 (SD=2.74); provincial cities, 27.72 (SD=2.75); county-level cities, 27.48 (SD=3.39); and town and rural, 27.42 (SD=2.90). Scores according to high school course concentration were social science, 27.60 (SD=2.80), and natural science, 27.82 (SD=3.35). Scores according to family economic condition were excellent, 28.00 (SD=1.00); good, 27.61 (SD=2.82); just ok, 28.03 (SD=3.45); and poor, 22.00 (SD=1.00). Scores according to parental job were labor, 27.86 (SD=3.13); farmer, 27.67 (SD=3.25); businessman, 27.23 (SD=2.58); white collar, 27.73 (SD=2.92); and military and police, 27.82 (SD=2.96). Scores according to experience in environmental education were those who have taken related course(s), 28.42 (SD=2.78); those who have not, 27.52 (SD=3.01); and those who were currently taking a course, 29.08 (SD=1.68). Scores according to political ideology were pro-ruling party, 27.43 (SD=3.01); pro-opposition party, 27.93 (SD=3.83); and no political ideology, 27.75 (SD=2.89). Table 4 further shows frequencies and percentages of the 11 environmental behaviors of the preservice teachers. Smoking among subjects in the study was rare. Of these 493 subjects, 443 (87.7%) reported never smoking, 40 (8.1%) seldom smoking, 11 (2.2%) often smoking, and 8 (1.8%) always smoking. When they were asked, "Do you keep all faucets from leaking?" 75.9% (374) reported always, 22.3% (110) often, 1.0% (5)

Table 4. Frequencies and Percentages of Environmental Behavior of Preservice Elementary Teachers

Items	Never N (%)	Seldom N (%)	Often N (%)	Always N (%)
B1 Smoking	433 (87.8)	40 (8.1)	11 (2.2)	9 (1.8)
B2 Keeping faucets from leaking	4 (.8)	5 (1.0)	110 (22.3)	374 (75.9)
B3 Participating in cleaning activities	24 (4.9)	192 (38.9)	200 (40.6)	77 (15.6)
B4 Turning off lights and electrical appliances	6 (1.2)	35 (7.1)	252 (51.1)	200 (40.6)
B5 Reading environmental articles	4 (4.9)	354 (71.8)	105 (21.3)	10 (2.0)
B6 Using products in aerosol cans	108 (21.9)	334 (67.7)	44 (8.9)	7 (1.4)
B7 Picking up litter in public areas	61 (12.4)	315 (63.9)	108 (21.9)	9 (1.8)
B8 Sorting garbage for recycling	30 (26.4)	282 (57.2)	68 (13.8)	13 (2.6)
B9 Reporting pollution problems	383 (77.7)	93 (18.9)	10 (2.0)	7 (1.4)
B10 Supporting pro-environment candidates	185 (37.5)	74 (15.0)	151 (30.6)	83 (16.8)
B11 Participating in environmental activities	400 (81.1)	75 (15.2)	15 (3.0)	3 (.6)

seldom, and .8% (4) never. Among all subjects, 40.6% reported often participating in school cleaning activities, 15.6% always, 38.9% seldom, and 4.9% never. When they were asked, "When leaving a room, do you turn off all electrical appliances and lights no longer needed?" 200 (40.6%) reported always, and 252 (51.5%), often. A majority (71.8% seldom and 4.9% never) of the preservice teachers did not subscribe to environment-related reading. When they were asked, "How often do you use products in aerosol cans?" 108 (21.9%) reported never, 334 (67.7%) seldom, 44 (8.9%) often, and 7 (1.4%) always. When asked, "Do you sort your garbage for recycling?" a majority (83%) of the subjects reported seldom (57.2%) or never (26.4%). When asked, "When you see a litter, do you pick it up and dispose of it properly?" a majority (76%) responded seldom or never. Of the 493 subjects, 77.7% said they had never reported any pollution problem to the proper authorities, 18.9% indicated seldom, 2.0% reported often, and 1.4% reported always. Item 10 in the scale asked, "Do you support pro-environment candidates during a political campaign?" Only 16.8% reported always, while 30.6% reported often, 15% seldom, and 37.5% never.

A majority (81.1%) of the subjects reported never having participated in activities sponsored by environmental organizations, 15.2% seldom, 3.0% often, and .6% always.

Correlations Among Environmental Behavior, Behavioral Intention, Attitudes, Worldview, and Knowledge

Research question 2 asked, "Is there any relationship among environmental behavior, intention, attitudes, worldview, and knowledge of the preservice elementary teachers?" To answer this question, a correlation analysis was performed using mean scores of the Environmental Behavioral Scale, the Behavioral Intention Scale, the Environmental Attitude Scale, the Environmental Worldview Scale, and the Environmental Knowledge Scale to determine the correlation coefficients among these variables. Table 5 shows the correlation matrix. Environmental behavior was significantly and positively correlated with environmental behavioral intention ($r=.2963$, $p<.001$) and environmental attitude ($r=.1294$, $p<.01$), but not with environmental worldview and environmental knowledge. Environmental behavioral intention was significantly and positively correlated with environmental attitude ($r=.37$, $p<.001$), environmental worldview ($r=.14$, $p<.05$), and environmental knowledge ($r=.17$, $p<.001$). Environmental attitude was found to be correlated significantly and positively with environmental worldview ($r=.55$, $p<.001$) and environmental knowledge ($r=.32$, $p<.001$). Environmental worldview was significantly and positively correlated with environmental knowledge ($r=.19$, $p<.001$). From the results of this analysis, research hypothesis 1 was rejected.

Table 5. Correlation Matrix of Environmental Behavior, Intention, Worldview, Attitudes, and Knowledge

	TOTB	TOTI	TOTW	TOTN	TOTK
TOTB					
TOTI	.2963**				
TOTW	.1294*	.3708**			
TOTN	.0800	.1351*	.5494**		
TOTK	-.0092	.1709**	.3183**	.1896**	

TOTB: Mean score on the Environmental Behavior Scale

TOTI: Mean score on the Environmental Behavioral Intention Scale

TOTW: Mean score on the Environmental Attitude Scale

TOTN: Mean score on the NEP Scale

TOTK: Mean score on the Environmental Knowledge Scale

N= 493, Significance: *p<.01, **p<.001 (Two-tailed test)

Predicting Environmental Behavior, Intention, Worldview,
Attitudes, and Knowledge from Predisposing and
Sociodemographic Factors

One of the purposes of the present study was to examine whether environmental behavior, intention, attitudes, worldview, and knowledge can be predicted from predisposing factors. The present research assumes that

1. sociodemographic factors predispose knowledge,
2. knowledge and sociodemographic factors predispose environmental worldview,
3. worldview, knowledge, and sociodemographic factors predispose environmental attitudes,
4. attitudes, worldview, knowledge, and demographic factors predispose behavioral intention, and
5. behavioral intention, attitudes, worldview, knowledge, and sociodemographic factors predispose behavior.

Hence, the prediction of environmental concerns followed this assumption. These predictions were conducted by a series of multiple regression analyses.

In order to fit multiple regression models, the sociodemographic variables (see Table 2) which were categorically measured were recorded or recategorized. In the multiple equations, the gender "female" was coded as 1 and "male" as 0. Accordingly, the category "natural science" in the high school course concentration variable was coded as 1 and "social science" as 0. For variables that were measured by more than two categories, when

comparing one category with other categories in the same variable, the specific category was recorded as 1, and all other categories were recorded as 0. According to this procedure, the variable "parental job" formed five variables in the multiple regression equations: J1 (labor), J2 (farmer), J3 (businessman), J4 (white collar), and J5 (military and police); the variable "study interest" formed three variables: U1 (social sciences), U2 (natural sciences), and U3 (art, music, and other skills); the variable "academic discipline" formed four variables: D1 (elementary education), D2 (language education), D3 (social studies), and D4 (mathematics and science); the "residence" variable formed four variables: R1 (national city), R2 (provincial city), R3 (county level city), and R4 (town and rural); the variable "region of college location" formed four variables: C1 (north), C2 (middle), C3 (east), and C4 (south); the variable "political ideology" formed three variables: P1 (pro-current ruling party), P2 (pro-opposition party), and P3 (no political ideology); the variable "environmental education experience" formed three variables: S1 (have taken an environmental education course), S2 (have not), and S3 (currently taking). Table 6 shows the abbreviation and description of these variables as well as means and standard deviations used in multiple regression equations.

Table 6. Means and Standard Deviations of Criteria and Predictors Used in Multiple Regression Equations

Variable	Mean	Std Dev	Variable Description
TOTB	27.667	2.981	Total score, Behavior Scale
TOTI	5.746	1.734	Total score, Intention Scale
TOTW	47.826	5.376	Total score, Weigel Scale
TOTN	39.138	4.521	Total score, NEP Scale
TOTK	9.333	1.960	Total score, Knowledge Scale
SEX	.515	.500	Gender, (being a female)
AGE	20.943	1.487	Actual age(years)
R1	.158	.365	Residence, national city
R2	.130	.336	Residence, provincial city
R3	.187	.390	Residence, county-level city
R4	.525	.500	Residence, town and rural
D1	.256	.437	Major, elementary education
D2	.247	.432	Major, language education
D3	.235	.425	Major, social studies
D4	.262	.440	Major, math and science education
C1	.252	.434	Region, North
C2	.262	.440	Region, Middle
C3	.231	.422	Region, East
C4	.256	.437	Region, South
ECO	2.211	.437	Economic condition
HIG	.310	.463	High school major
S1	.126	.332	EE experience, have taken
S2	.850	.358	EE experience, not yet
S3	.024	.154	EE experience, currently taking
P1	.296	.457	Party, pro-ruling party
P2	.059	.236	Party, pro-opposition party
P3	.645	.479	Party, neutral or others
U1	.475	.500	Study interest, social sciences
U2	.300	.459	Study interest, natural sciences
U3	.225	.418	Study interest, art et al.
J1	.323	.468	Parental job, labor
J2	.166	.373	Parental job, farmer
J3	.191	.393	Parental job, businessman
J4	.252	.434	Parental job, white collar
J5	.069	.254	Parental job, military, police.

N of Cases = 493

Predicting Environmental Behavior from Predisposing and Sociodemographic Variables

Research question 3 asked, "To what extent can selected predisposing and sociodemographic variables predict environmental behavior of preservice elementary teachers?" Responses were analyzed using multiple regression analysis, with environmental behavior as the criterion and all the predisposing and sociodemographic variables as predictors.

The outcome of the multiple regression analysis is summarized in Table 7. Environmental behavior was found to be significantly associated with the predisposing and sociodemographic variables ($R=.41$, $p<.00005$). The proportion of the variance of environmental behavior that could be accounted for by the combination of the predisposing and sociodemographic variables was 16%. From the results, null hypothesis 2 was rejected.

Further examination of the regression coefficients indicated that only six of these predictors significantly predicted environmental behavior, one from predisposing categories and five from sociodemographic categories. The environmental behavioral intention variable was significantly related to environmental behavior ($\text{Beta}=.30$, $p<.0001$). Among the sociodemographic category, one of the residence variables, R1 (national city), was related to the criterion significantly ($\text{Beta}=.16$, $p<.001$). Two region variables were significantly related to environmental behavior: C3 (east) at .01 level ($\text{Beta}=.16$) and C1 (north)

Table 7. Multiple Regression Analysis of Environmental Behavior by Predisposing and Sociodemographic Variables

Variable Description	B ¹	Beta ²	t
TOTI (Behavior intention)	.47095	.30163	6.401***
U1 (Interest, social science)	.19700	.03306	.538
S3 (EE experience, taken)	2.04882	.10603	2.445*
R2 (Residence, provincial city)	.27741	.03131	.682
J1 (Parental job, labor)	.12289	.01929	.371
C2 (Region, middle)	.49674	.07332	1.374
P1 (Party, pro-ruling)	-.23657	-.03627	-.824
D1 (Major, elementary education)	.11036	.01617	.154
AGE (Actual age, years)	-.01926	.00096	-.206
TOTN (Environmental worldview)	.03785	.05741	1.081
J5 (Parental job, milit. & poli.)	.06534	.00032	.072
ECO (Economic condition)	.16822	.02468	.552
S1 (EE experience, have taken)	.76316	.08498	1.934*
R3 (Residence, county-city)	.20863	.02730	.584
P2 (Party, pro-opposition)	.68999	.05452	1.211
TOTK (Environmental knowledge)	-.08187	-.05383	-1.129
SEX (Gender, being a female)	.34376	.05769	1.255
R1 (Residence, national city)	1.32044	.16183	3.427***
C3 (Region, east)	1.04729	.14829	2.786**
J3 (Parental job, businessman)	-.37753	-.04980	-.986
D2 (Major, language education)	.07305	.01059	.102
U3 (Interest, art and skills)	-.21532	-.02805	-.522
J2 (Parental job, farmer)	.30508	.03815	.725
C1 (Region, north)	.72023	.10494	1.926*
TOTW (Environmental attitude)	-.00028	-.00051	-.088
HIG (High school course concen.)	.34888	.05420	.543
D3 (Major, social studies)	-.36486	-.05197	-.498

N= 493. Multiple R= .40569. R^2 = .16458. Adjusted R^2 = .11607.

F= 3.39284. ($P < .00005$). (DF=27, 465).

¹B: regression coefficient (slope).

²Beta: standardized regression coefficient.

* $p < .05$, ** $p < .01$, *** $p < .0001$.

at .05 level ($\text{Beta}=.10$). Two types of environmental education experience, S3 and S1 (currently taking and have taken), correlated with the criterion at .05 level with the regression coefficients being .11 and .08, respectively. The result of this multiple regression analysis indicated the following:

1. Preservice elementary teachers' environmental behavior had a rather strong and positive association with environmental behavioral intention.
2. Environmental attitudes, worldview, and knowledge failed to predict the preservice elementary teachers' environmental behavior.
3. Preservice elementary teachers enrolled in teachers colleges in the eastern and northern regions practiced more environmental behavior than those who were not.
4. Preservice elementary teachers from national cities practiced more environmental behavior than those from other areas.
5. Preservice elementary teachers who had taken or who were taking environment-related courses practiced more environmental behavior than those who did not take such courses.
6. Preservice elementary teachers' environmental behavior was not different according to their age, high school course concentration, family economic condition, parental job, and study interest.

In conclusion, those preservice elementary teachers who were from national cities, who enrolled in teachers colleges in the eastern or northern regions, who had taken or were currently taking environmental education course(s), and who expressed more environmental behavioral intention displayed more environmental behavior.

Predicting Environmental Behavior Intention from
Predisposing, and Sociodemographic Variables

Research question 4 asked, "To what extent can selected predisposing and sociodemographic variables predict environmental behavioral intention of preservice elementary teachers?" To answer this question, a multiple regression analysis was performed. In the regression equation, environmental behavioral intention was the criterion and all other predisposing variables and sociodemographic variables were entered simultaneously as predictors. The outcome of the regression analysis is presented in Table 8. Multiple regression analysis indicated that a significant association existed between the predictors and the criterion ($R=.44$, $p<.00005$). The results indicated that hypothesis 3 should be rejected. Variance in environmental behavioral intention that could be accounted for by the predisposing and sociodemographic variables was 19%. A further examination of the regression coefficients indicated that only the environmental attitude variable and the political ideology variable P2 (pro-opposition party) were significantly associated with environmental behavioral intention. The

Table 8. Multiple Regression Analysis of Environmental Behavioral Intention by Predisposing and Sociodemographic Variables

Variable	Description	B ¹	Beta ²	t
TOTW	(Environmental attitude)	.13932	.39228	7.200***
D2	(Major, language education)	.41776	.09453	.931
C2	(Region, middle)	-.05582	-.01286	-.245
R3	(Residence, county city)	-.24386	-.04981	-1.085
U3	(Interest, art and skill)	.33219	.06757	1.442
AGE	(Actual age, years)	-.04957	-.03862	-.844
J1	(Parental job, labor)	.08034	.01969	.385
P3	(Party, no ideology)	-.01608	-.00040	-.089
S3	(EE experience, taking)	-.20517	-.01658	-.389
J5	(Parental job, mili. & poli.)	.40011	.03099	.700
S1	(EE experience, have taken)	.00035	.00062	.014
ECO	(Economic condition)	-.17878	-.04094	-.933
R2	(Residence, provincial city)	.09910	.01746	.387
HIG	(High school course conc.)	-.05021	-.01218	-.124
SEX	(Gender, being a female)	.04566	.01196	.265
R1	(Residence, national city)	.09055	.01733	.373
C3	(Region, east)	.07774	.01719	.328
P2	(Party, pro-opposition)	-.93392	-.11522	-2.511*
J3	(Parental job, businessman)	.07452	.01535	.309
TOTK	(Environmental knowledge)	.07107	.07295	1.561
D3	(Major, social studies)	.02841	.00063	.062
TOTN	(Environmental worldview)	-.03624	-.08582	-1.648
J2	(Parental job, farmer)	.07952	.01553	.300
C1	(Region, north)	.14000	.03185	.595
U2	(Interest, natural science)	.17487	.04203	.760
D1	(Major, elementary ed.)	-.24873	-.05689	-.552

N= 493. Multiple R= .43699. R^2 = .19096. Adjusted R^2 = .14582
F= 4.23054. (P<.00005). (DF=26, 466).

¹B: regression coefficient (slope).

²Beta: standardized regression coefficient.

*p<.05, **p<.01, ***p<.0001.

environmental attitude measure related to the criterion positively and significantly at the .00005 level ($Beta=.39$).

The political ideology variable, P2, was significantly and negatively related to the criterion at .01 level ($Beta=.12$). No other sociodemographic variables showed significant association with the criterion. Hence, we can conclude the following:

1. The preservice elementary teachers with a more positive environmental attitude had stronger environmental behavioral intention.

2. Subjects with pro-opposition partisan ideology had less environmental behavioral intention.

3. The preservice elementary teachers' environmental behavioral intention showed no differences according to age, gender, academic discipline, high school course concentration, study interest, region of college location, family economic status, and parental job.

Predicting Environmental Attitudes from Predisposing and Sociodemographic Variables

Research question 5 asked, "To what extent can predisposing and selected sociodemographic variables predict environmental attitudes of preservice elementary teachers?" To answer this question, a multiple regression analysis was performed. The criterion was the measure of the environmental attitude scale, and the predictors were the environmental worldview, knowledge and sociodemographic variables. Table 9 summarizes the results of this multiple

regression analysis, which revealed that a significant association existed between the predictors and criterion ($R=.64$, $p<.00005$). This result indicated that null hypothesis 4 should be rejected. All of these predictors were found to account for 42% of the variance of the environmental attitude. A further examination of the regression coefficients revealed that environmental worldview, knowledge, economic, and study interest variables U3 and U1 were related significantly to the criterion. Environmental worldview was the most powerful ($Beta=.52$, $p<.00005$) predictor of the criterion. The second most powerful predictor was the knowledge variable ($Beta=.23$, $p<.00005$). Both the U1 and U3 variables related to the criterion at .05 level, with regression coefficients being .11 and .10, respectively. Both the economic (ECO) and parental job (J3, businessman) variables were significantly and negatively related to the criterion at the .01 level with the same regression coefficient ($Beta=-.12$). The results supported the following:

1. The stronger the preservice elementary teachers endorsed the NEP, the more positive attitude toward the environment they held.

2. The higher the environmental knowledge of the preservice elementary teachers, the more positive their environmental attitude.

2. Subjects who were interested in study social sciences or art, music, and other skill subjects had a more positive environmental attitude than those who were not interested in these subjects.

3. Subjects from families in better economic conditions showed greater concern about the environment.

4. Subjects from a business-oriented family had less environmental concern than their nonbusiness family counterparts.

5. Subjects' environmental attitudes showed no differences according to age, sex, residence, academic discipline, high school course concentration, region of college location, and environmental education experience.

Predicting Environmental Worldview from Knowledge and Sociodemographic Variables

Research question 6 asked, "To what extent can environmental knowledge and selected sociodemographic variables predict environmental worldview of preservice elementary teachers?" To answer this question, a multiple regression analysis was performed. In this multiple regression model, the knowledge variable and the sociodemographic variables were entered as predictors, and the environmental worldview measure served as the criterion. Table 10 summarizes the results of this multiple regression analysis, which revealed that a significant association existed between the predictors and the criterion ($\beta = .29$, $p < .005$). The results indicated that null hypothesis 5

Table 9. Multiple Regression Analysis of Environmental Attitude by Predisposing and Sociodemographic Variables

Variable	Description	B ¹	Beta ²	t
TOTN	(Environmental worldview)	.62295	.52388	14.163***
S3	(EE experience, taking)	1.27582	.03661	1.012
J2	(Parental job, farmer)	.22512	.01561	.372
D1	(Major, elementary ed.)	-1.00015	-.08124	-.929
P2	(Party, pro-opposite)	1.30328	.05710	1.534
S1	(EE experience, have taken)	-.23621	-.01458	-.398
C1	(Region, north)	1.67238	.13512	3.041**
J5	(Parental job, mili. & poli.)	2.42967	.06683	1.795
ECO	(Economic condition)	-1.47216	-.11974	-3.249**
AGE	(Actual age, years)	.02260	.00062	.161
R2	(Residence, provincial city)	.38210	.02391	.624
U1	(Interest, social sciences)	1.14394	.10646	2.087*
P1	(Party, pro-ruling)	-.33765	-.02871	-.781
J3	(Parental job, businessman)	-1.65626	-.12116	-2.933**
R3	(Resident, county city)	-.39602	-.02873	-.737
TOTK	(Environmental knowledge)	.62201	.22676	5.924***
SEX	(Gender, being a female)	.36914	.03435	.896
C3	(Region, east)	-.27110	-.02128	-.484
R1	(Region, national city)	.07539	.00051	.130
D2	(Major, language education)	-.68509	-.05505	-.639
J4	(Parental job, white collar)	.07511	.00063	.150
U3	(Interest, art and skills)	1.43297	.10352	2.320*
C4	(Region, south)	.37363	.03035	.687
HIG	(High school major)	-.58337	-.05026	-.603
D3	(Major, social sciences)	-1.26388	-.09983	-1.147

N= 493. Multiple R= .64428. R²= .4150. Adjusted R²= .38378.

F= 13.25682. (P< .00005). (DF= 25, 467).

¹B: regression coefficient (slope).

²Beta: standardized regression coefficient.

*p<.05, **p<.01, ***p<.0001.

Table 10. Multiple Regression Analysis of Environmental Worldview by Knowledge and Sociodemographic Variables

Variable	B ¹	Beta ²	t
TOTK (Environmental knowledge)	.47955	.20788	4.437***
R1 (Residence, national city)	.82858	.06696	1.362
P3 (Party, no ideology)	.40672	.04309	.896
J5 (Parental job, mili.)	-2.03317	-.06649	-1.424
D1 (Major, elementary ed.)	2.43231	.23493	2.160*
S3 (EE experience, taking)	-.29909	-.01021	-.226
ECO (Economic condition)	.03128	.00030	.066
C2 (Region, middle)	.11441	.01114	.200
U1 (Interest, social science)	-.26410	-.02923	-.459
J3 (Parental job, businessman)	-.05514	-.00047	-.092
AGE (Actual age, years)	.01358	.00046	.092
S1 (EE experience, have taken)	-.09412	-.00069	-.151
R2 (Residence, provincial city)	.91413	.06803	1.423
SEX (Gender, being a female)	.54970	.06083	1.271
R3 (Residence, county city)	.39728	.03427	.704
P2 (Party, pro-opposite)	.23941	.01247	.257
C3 (Region, east)	-.39182	-.03658	-.660
J1 (Parental job, labor)	.18135	.01877	.346
D2 (Major, language education)	2.12905	.20345	1.896
U3 (Interest, art and skills)	.01317	.00011	.020
J2 (Parental job, farmer)	.16743	.01381	.251
C1 (Region, north)	-1.33838	-.12859	-.288
HIG (High school course conc.)	1.49820	.15348	1.478
D3 (Major, social studies)	2.96866	.27884	2.581**

N= 493. Multiple R= .29092. R^2 = .08464. Adjusted R^2 = .03769
 F= 1.80298. (p= .0118). (DF= 24, 468).

¹B: regression coefficient (slope).

²Beta: standardized regression coefficient.

*p<.05, **p<.01, ***p<.0001.

should be rejected. However, only 8.5% of the variance of the environmental worldview could be accounted for by these predictors. A further examination of the regression coefficients revealed that the environmental knowledge variable and two academic discipline variables (D1 and D3) were significantly linked to the environmental worldview measure. The knowledge variable related to the criterion positively and significantly ($\text{Beta}=.21$, $p<.0001$). Of the two academic discipline variables, D3 (social studies) associated with the criterion variable at the .01 level ($\text{Beta}=.28$) and D1 (elementary education) at the .05 level ($\text{Beta}=.23$). The results indicated the following:

1. Subjects with higher environmental knowledge showed greater NEP worldview.

2. Subjects majoring in social studies and elementary education showed greater support of the NEP worldview than subjects who were not majoring in these two academic disciplines.

3. Age, sex, economic status, parental job, residence, region of college location, environmental education experience, study interest, and high school course concentration did not affect the subjects' environmental worldview.

Predicting Environmental Knowledge from Sociodemographic Variables

Research question 7 asked, "To what extent can selected sociodemographic variables predict environmental knowledge

of preservice elementary teachers?" To answer this question, a multiple regression analysis was performed by using environmental knowledge as the criterion and sociodemographic variables as predictors. The outcome of the regression analysis is summarized in Table 11. Sociodemographic predictors were significantly associated with environmental knowledge criterion ($R=.33$, $p=.0002$). These sociodemographic variables explained 11% of the variance of environmental knowledge among the preservice elementary teachers. The results indicated that null hypothesis 6 should be rejected. Further investigation of the regression coefficients showed that the academic discipline variable D2 (language education), the region variable C3 (east), and the study interest variable U3 (interested in art music, and other skill subjects) were significantly and negatively related to environmental knowledge (D2: $\text{Beta}=-.21$, $p<.05$; C3: $\text{Beta}=-.17$, $p<.01$; U3: $\text{Beta}=-.12$, $p<.01$). The results indicate the following:

1. Preservice elementary teachers majoring in language education were less knowledgeable in the environment than their nonlanguage major counterparts.

2. Preservice elementary teachers who enrolled in the colleges in the eastern region showed lower environmental knowledge than their counterparts in other regions.

3. Preservice elementary teachers who were interested in studying art, music, and other skill subjects showed

Table 11. Multiple Regression Analysis of Environmental Knowledge by Sociodemographic Variables

Variable	Description	B ¹	Beta ²	t
AGE	(Actual age, years)	.09927	.07534	1.578
U3	(Interest, art and skills)	-.62852	-.12456	-2.560**
ECO	(Economic condition)	.24707	.05513	1.217
D2	(Major, language education)	-.99132	-.21852	-2.076*
C3	(Region, east)	-.78108	-.16822	-3.141**
S1	(EE experience, have taken)	.11596	.01964	.435
P2	(Party, pro-opposite)	-.51279	-.06163	-1.347
R2	(Residence, provincial city)	-.51950	-.08919	-1.901
S3	(EE experience, taking)	-.29522	-.02324	-.522
J5	(Parental job, mili. & poli.)	.69232	.05223	1.136
J3	(Parental job, businessman)	.42411	.08510	1.660
P1	(Party, pro-ruling)	.26814	.06253	1.386
R3	(Residence, county city)	.43890	.08735	1.828
SEX	(Gender, being a female)	.18412	.04700	.998
HIG	(High school course conc.)	-.34998	-.08271	-.809
R1	(Residence, national city)	-.06891	-.01285	-.265
C1	(Region, north)	.38609	.08557	1.579
J1	(Parental job, labor)	.30313	.07238	1.355
D3	(Major, social studies)	-.53185	-.11524	-1.084
J2	(Parental job, farmer)	.06880	.01309	.242
C4	(Region, south)	-.10243	-.02282	-.419
U2	(Interest, natural science)	-.18221	-.04266	-.741
D1	(Major, elementary education)	-.72787	-.16217	-1.517

N= 493. Multiple R= .33041. R²= .10917. Adjusted R²= .06548.
 F= 2.49896. (p=.0002). (DF= 23, 469).

¹B: regression coefficient (slope).

²Beta: standardized regression coefficient.

*p<.05, **p<.01, ***p<.0001.

lower environmental knowledge than those who were not interested these subjects.

4. Preservice elementary teachers' environmental knowledge was not different according to age, sex, residence, economic condition, parental job, or high school course concentration, but their environmental knowledge did differ by academic discipline and the region of college location.

Discussion

This study assessed environmental knowledge, worldview, attitudes, behavioral intention, and behavior of the preservice elementary teachers in Taiwan, Republic of China. In addition, relationships among environmental behavior, behavioral intention, attitudes, worldview, and knowledge were investigated. Further, the predictability of environmental behavior, behavioral intention, attitude, worldview, and knowledge from their respective predisposing and sociodemographic variables was also examined.

Discussion of the results from the study is presented in the following sections: 1) assessment of environmental knowledge, worldview, attitudes, behavioral intention, and behavior; 2) relationships among environmental behavior, behavioral intention, attitudes, worldview, and knowledge; and 3) prediction of environmental behavior, behavioral intention, attitudes, worldview, and knowledge from their respective predisposing and sociodemographic variables.

Assessment of Environmental Knowledge, Attitudes, Behavioral Intention, and Behavior

In this section, the preservice elementary teachers' scores of environmental knowledge, worldview, attitude, behavioral intention, and behavior are compared with existing data using comparable instruments. The differences of these scores among different sociodemographic groups are further discussed in the third section.

Environmental knowledge

The preservice elementary teachers' mean score of environmental knowledge as assessed by the Environmental Knowledge Scale was 9.33 ($SD=1.96$). The environmental knowledge was compared with results of other college students' environmental knowledge surveys using the same instrument. In Maloney et al.'s (1975) California college student sample ($N=56$), the mean score of environmental knowledge was 8.64 ($S.D.=2.76$) and the mean score for a Sierra Club sample ($N=31$) was 11.38 ($S.D.=2.18$). In Dispoto's (1977) Rutgers University student sample ($N=140$), the mean was 9.77 ($S.D.=2.33$). The mean scores for Borden's (1979) Purdue University student sample ($N=530$) were 7.35 ($SD=2.46$), and for the Canadian college sample ($N=136$) of Gifford et al. (1983) were 9.01 ($SD=2.67$). From Table 12 we can see that the preservice elementary teachers' environmental knowledge score was comparable to their Western college counterparts. The preservice elementary teachers' score ranked second among the four college groups;

Table 12. Environmental Knowledge Scale Scores for Different Groups

Studies	N	Mean	SD
Teachers college students, Taiwan, R.O.C. ¹	493	9.33	1.96
College students, California ²	56	8.64	2.76
College students, Rutgers University ³	104	9.77	2.33
College students, Purdue University ⁴	530	7.35	2.46
College students, British Columbia ⁵	136	9.01	2.67
Sierra Club members, California ²	31	11.38	2.18

¹Present study²Maloney et al. (1975)³Dispoto (1977)⁴Borden & Schettino (1979)⁵Gifford et al. (1983)

however, their score was lower than that of the Sierra Club Sample.

As this scale was developed in the United States, the present study further proved that it is a useful instrument for cross-cultural comparison of environmental knowledge.

Environmental worldview

The environmental worldview of preservice elementary teachers was assessed by the NEP Scale (Dunlap & Van Liere, 1978). The mean scores of the present study as well as other related studies are shown in Table 12. The mean score of the preservice elementary teachers was 3.26. Scores for their general population sample (GPS) and an environmental organization sample (EOS) were 3.0 and 3.7, respectively. Another study conducted by Albrecht et al. (1982) indicated the mean score for a sample of farmers was 2.9 and for a sample of urbanites was 3.2. In a recent study, Shetzer, Stackman, & Moore (1991) assessed a Canadian college student sample's NEP and found the mean score was 2.93 (the score was transformed from a mean of 5.13 on a seven-point scale into four-point scale for comparison). By comparing scores in Table 13, we can see that the preservice elementary teachers scored higher on the NEP scale than their Canadian college counterparts, the general American public, and the farmers' group, although their score was lower than that of the EOS group. Dunlap and Van Liere (1978) indicated that the support of NEP worldview by Western people is related mainly

Table 13. Environmental Worldview Scores Scale for Different Groups

Studies	N	Mean*
Present Study		
Preservice elementary teachers	493	3.3
Iowa Study ¹		
Farmers	348	2.9
Urbanites	407	3.2
Washington Study ²		
General population (GPS)	806	3.0
Environmental Organization (EOS)	407	3.7
Canadian Study ³		
College students	237	2.9

*Means were standardized on a four-point scale

¹Albrecht et al. (1982)

²Dunlap & Van Liere (1978)

³Shetzer et al. (1991)

to their postmaterial value. However, due to a difference in degree of industrialization and differences in the traditional cultures of Western and Chinese societies, the determinants for supporting the NEP worldview for the preservice elementary teachers may be different from that of their Western counterparts. Pierce, Lovrich, and Tsurutani (1987) compared a Japanese sample with an American sample and found that Japanese subjects had a greater support for the NEP worldview than their American counterparts. These researchers indicated that Japanese subjects' support of the NEP view was reinforced by their traditional cultural nature. Traditional Oriental view of the interrelationship between man and nature may be quite different from that of Westerners. The researchers further indicated that in their two study sites, approximately the same proportions of the subjects were postmaterial NEP supporters (10% and 9%); however, three times as many Japanese as Americans were materialist NEP supporters (15% versus 5%).

Environmental attitudes

Preservice elementary teachers' environmental attitudes were determined by Weigel's Environmental Concern Scale. Their mean score on the scale was 47.8 (SD=5.4). In Weigel and Weigel's (1978) study, the mean score on the scale was 54.5 (S.D.=6.6) for a Sierra Club sample and 44.2 (S.D.=8.4) for a general population sample. By comparing the result of present study with that of Weigel and Weigel (1978), we can

see that the environmental attitudes of the preservice elementary teachers fell in between the Sierra Club group and the general population group (Table 14).

Environmental behavioral intention

The preservice elementary teachers' environmental behavioral intention was assessed by using the Verbal Commitment Scale (Maloney et al., 1975). The mean score for the preservice elementary teachers was 6.56 (S.D.=1.91). The study showed the mean score for college sample was 6.37 (S.D.=2.48), for non-college group, 5.02 (S.D.=2.75), and for Sierra group, 8.68 (S.D.=1.72). The mean score for another college group in Borden and Schettino's (1979) study was 6.12 (SD=2.03), and for Gifford, Hay, and Boro's (1983) college sample was 6.94 (SD=1.89). Table 15 presents the means and standard deviations of environmental behavioral intention for these college samples as well as a known environmental group and a non-college student sample. An examination of data presented in Table 15 shows that the subjects in the present study intended to improve the environment no less than their Western college counterparts.

Environmental behavior

The environmental behavior of the preservice teachers was determined by the Environmental Behavior Scale. The mean score for the subject was 27.6 (SD=3.34). From Table 4 we can see that, as expected, a majority (88%) of the subjects were nonsmokers. Students with higher academic

Table 14. Environmental Attitude Scale Scores for Different Groups

Population	N	Mean	SD
The Present Study			
Preservice elementary teachers	493	47.8	5.4
American Study*			
Sierra Club group	126	54.5	6.6
General population	162	44.2	8.4

*Weigel & Weigel (1978)

performance generally are less likely to smoke in high school in Taiwan. Preservice elementary teachers were those with high academic performances in high school. Also, smoking is discouraged in teachers colleges. Unlike American students, the subjects tended to use fewer aerosol cans because they usually did not have items in aerosol cans. Also, behaviors such as smoking and using aerosol cans (e.g., pesticide sprays) are directly related to personal health, and subjects may have been aware of these adverse effects. They tended to maintain the habits of keeping faucets from leaking and turning off electric appliances and lights. This may be attributed to the training of such habits since early childhood. Also, these energy conservation behaviors are cost related. About 40% of subjects reported that they never supported pro-environment candidates. This may be caused by low interest in political campaigns by subjects in Taiwan. Some subjects also indicated that they had not reached the legal age for voting. About 70% reported they seldom read environment-related articles, and some of them indicated that their colleges provided very little environment-related reading material. A majority (84%) of these subjects reported seldom or never sorting garbage, reporting pollution problems to authorities, or participating in activities sponsored by environmental groups. To express these behaviors requires further information, skills, and

Table 15. Environmental Behavior Intention Scale Scores for Different Groups

Population	N	Mean	SD
Preservice elementary teachers, Taiwan ¹	493	6.56	1.91
College students, California ²	56	6.37	2.48
College students, Purdue University ³	530	6.12	2.03
College students, British Columbia ⁴	136	6.94	1.89
Sierra Club group ²	31	8.68	1.72
Non-college student group ²	40	5.02	2.75

¹Present study²Maloney et al. (1975)³Borden & Schettino (1979)⁴Gifford et al. (1983)

strategies. Colleges and communities should provide opportunities for students to express such behaviors. Dunlap et al. (1973) indicated that college students, unlike much of the public, will give strong support to meaningful environmental activities. Therefore, it is important for teachers colleges as well as communities to provide opportunities, information, and skills for students to express these behaviors. The low frequencies in behaviors requiring skills and information were also found by other researchers. Wang and Tseng (1991) found that elementary teachers in Taiwan reported seldom or never exhibiting behaviors such as recycling garbage and participating in activities sponsored by environmental groups. Peyton and Hungerford (1980) found similar results in their study concerning American preservice and inservice teachers' environmental behavior.

Dunlap et al. (1973) noted that college students tend to initiate environmental activities that require neither expertise, in terms of detailed knowledge of an issue, nor a sustained commitment. Students are less subscribed to activities which need direct physical action or considerable commitment.

Subjects' fluctuation in some of these environmental behaviors may be related to a number of external and internal factors such as personality traits (De Young, 1986), moral norms (Happer & Stein, 1983), altruism (Happer

& Nielsen, 1991), and perceived consequence of behavior, evaluation of behavior, and judged influence of external events (Wicker, 1971).

Relationships Among Environmental Behavior, Intention, Attitudes, and Knowledge

Results of the present study revealed that environmental behavior significantly correlated with behavioral intention ($p < .001$) and general environmental attitude ($p < .01$), but not with environmental worldview and environmental knowledge. The magnitude of correlation coefficients decreased in gradient from intention ($r = .30$), to general attitude ($r = .13$), to worldview ($r = .08$), to knowledge ($r = .00$). These results further support the claim that attitudes measured in a more specific way correlate better with a given behavior measurement (Weigel, Vernon, & Tognacchi, 1974; Heberlein & Black, 1976). These researchers indicated that in order to increase the correspondence between attitude and behavior measures, the attitude measurement should be specific.

Results also indicated that preservice elementary teachers' environmental knowledge scores were significantly related to behavioral intention ($r = .17$), general environmental attitude ($r = .32$), and environmental worldview ($r = .19$) at the .001 level, but not with environmental behavior. The fact that inconsistency existed between knowledge and behavior was also reported in numerous other studies (Maloney et al., 1975; Borden & Schettino, 1979;

Gifford et al., 1983; Wang & Tseng, 1991). The low predictability of knowledge on behavior has caused some researchers to suggest that educational programs should be focused on the affective dimension instead of teaching environmental knowledge (Hendee, 1972). Some other researchers (Peyton & Hungerford, 1980; Hungerford & Volk, 1990) suggested that direct participation is a more desirable environmental education approach than teaching knowledge. However, the present study showed that, although environmental knowledge did not significantly correlate with behavior, it significantly correlated with attitudes and intention. This result implies that environmental knowledge will affect behavior through attitudes and behavioral intention, which was supported by a number of environmental educators (Stapp, 1985; Stapp & Polunin, 1991; Roth, 1972). These leading environmental education experts insisted that environmental knowledge is essential for citizens' responsible environmental behavior. Southern (1972) also indicated that "if the child acquires particular broad environmental understandings (knowledge), he will develop social conscience (attitude) that will affect his behavior (actions) toward the environment (p. 16)."

Predicting Environmental Behavior from Predisposing and Sociodemographic Variables

One of the purposes of this study was to examine if the PRECEDE model could be applied to explain environmental behavior. Only 16% of the variance of environmental

behavior of the preservice elementary teachers could be explained by the predisposing and sociodemographic variables. This result indicated that majority of factors affecting environmental behavior needs further investigated. Among the four predisposing factors, only the intention variable significantly predicted the criterion. Of the sociodemographic variables examined, only three (residence, region of college location, and experience of environmental education) were significantly related to environmental behavior. As expected, the respondents who had taken or who were taking environmental education courses reported more environmental behavior than those who have not. The result is consistent with the studies of Gifford et al. (1983) and Kunz (1990). Both studies showed that students who had taken or were currently enrolled in environmental classes reported more environmental behavior than others. The preservice elementary teachers from cities with a large population (over 1 million) reported more environmental behavior than those from other areas. This result also is consistent with the results of Buttel and Flinn (1976a) and Tremblay and Dunlap (1978). This finding further supports Van Liere and Dunlap's (1980) hypothesis that "urban residents are more likely to be environmentally concerned than rural residents (p. 653)." Tremblay and Dunlap (1978) offered two explanations for this relationship. First, urban residents are more concerned with environmental

problems because they generally are exposed to higher levels of pollution and other types of environmental deterioration. Second, rural residents are more likely than urban residents to have a utilitarian orientation toward the natural environment because of their involvement with "extractive" occupations such as farming and mining. Preservice elementary teachers who were enrolled in the two teachers colleges in the eastern region had higher environmental behavior than those who were in other regions. The eastern region is the least industrialized and least polluted area in Taiwan. This result appeared to contradict the result showed on residence variable; however, it should be noted that the two eastern colleges were located in the most populated cities of the region. Further, some other factors also could contribute to this inconsistency. For example, the eastern colleges might provide more opportunity for students to express environmental behavior, or some behaviors might even be mandated by the colleges. As a result of this analysis, the profile of a pro-environment preservice elementary teacher was one who promised to improve the environment, who lived in an urban area before enrolling in a teachers college, and who had taken or currently was taking environment-related courses.

Predicting Environmental Behavioral Intention from
Predisposing and Sociodemographic Variables

The predisposing and sociodemographic variables studied could explain 19% of the variance of the preservice

elementary teachers' environmental behavioral intention. However, among the three predisposing factors (environmental attitude, environmental worldview, and knowledge), only the attitude variable significantly predicted the criterion. The results indicate that environmental worldview and environmental knowledge may have contributed to behavioral intention through the way of environmental attitude, because the two variables were found to correlate significantly with the environmental attitude measure. Among the 10 sociodemographic variables studied, only the political ideological variable was significantly related to the behavioral intention. It appears that preservice elementary teachers' intention to improve the environment showed no difference according to age, gender, academic discipline, high school course concentration, residence, region of college location, family economic condition, parental job, and study interest. Students whose political ideology in favor of the opposition party showed less environmental behavioral intention. Van Liere and Dunlap (1980) hypothesized that "(American) Democrats and liberals are more concerned about environmental quality than their Republican and conservative counterparts (p. 184)." One explanation for the present finding may be made by borrowing the conclusion of Dunlap et al. (1973). They indicated that environmental reforms mean an extension of government activities and regulations. Those who opposed the extension

of governmental activities or regulation also expressed less willingness to improve environmental quality.

Predicting Environmental Attitudes from Predisposing and Sociodemographic Variables

Environmental attitude was predicted significantly by environmental worldview, knowledge, and sociodemographic variables. The combination of these variables could account for 42% of the variance of environmental attitude. The variables of family economic condition, parental job, and study interest were significantly related to environmental attitude measure. Respondents from a higher economic status expressed more a positive attitude toward pollution and conservation. This finding was consistent with that of a number of studies (Van Liere & Dunlap, 1980; Malkis & Grasmick, 1977). All of these studies indicated that individuals having better economic conditions also have a more positive attitude about improving environmental quality. This result may be explained by the assumption of Morrison et al. (1972) who indicated that individuals with a lower economic status have experienced only poor physical conditions and thus are sensitive to the fact that they live, work, and play in polluted, overcrowded conditions; hence, they are more likely to have less concern about environmental quality. The finding that sons or daughters of businessmen expressed less sensitive environmental attitudes than others may be because businessmen's families showed more concern about the benefits of economic growth

than environmental quality (Malkis & Grasmick, 1977). Preservice elementary teachers who were interested in studying art, music, and skill subjects also expressed more positive environmental attitudes. This could be related to their pursuit of more aesthetic aspects of human existence (Maslow, 1970).

Predicting Environmental Worldview from Predisposing and Sociodemographic Variables

Preservice elementary teachers' environmental worldview was predicted by environmental knowledge and sociodemographic variables. The knowledge variable and two academic discipline variables positively and significantly related to environmental worldview. Social studies majors and elementary education majors were found to support the environmental worldview stronger than those who were majoring in other areas. As indicated by Pierce et al. (1987), Oriental support of the NEP view may not be due to the same reasons as for Western supporters. Students' support of the NEP could be related partly to their traditional belief of the interrelationship of man and nature in addition to their positive attitudes toward the environment.

Predicting Environmental Knowledge from Demographic Variables

The demographic variables studied in the present study included gender, age, residence, academic discipline, high school course concentration, region of school location,

parental job, family economic status, political ideology, experience of environmental education, and study interest. These 10 sociodemographic variables could account for only 8% of the variance of environmental knowledge. Only the variables of region of college location, academic discipline, and study interest showed statistical significant association with the knowledge variable. Students in the eastern region were less knowledgeable in environment. One possible explanation is that environmental knowledge is confounded with academic performance. Students in colleges in the eastern region generally had a poorer performance on the National Joint Entrance Examination for Universities and Colleges than those in the other three regions. Students majoring in language education also showed less knowledge on environmental issues than those majoring in other academic areas. The most possible explanation is that students in language education have less opportunity or are less likely to access knowledge about the environment and related issues. Furthermore, the instrument for assessing knowledge used in the present study was rather science oriented. For example, one item in the instrument asked, "What is the harmful effect of phosphates on marine life? A) Cause cancer, B) Render fish sterile, C) Induce nervous reactions in fish, D) Make water cloudy, E) Feed algae which suffocate fish." The correct response for this item is "E, Feed algae which suffocate fish." It could be

understood that students not having a good background of ecology would have trouble answering these questions. The influence of academic orientation on environmental knowledge also has been demonstrated by other researchers (Wang & Tseng, 1991; Chan et al., 1991; Gifford et al., 1983). These researchers indicated that humanistic majors have a poor environmental knowledge in comparison to nonhumanistic majors.

Also, the results of several multiple regression analyses revealed that an inconsistency in environmental knowledge and environmental behavior existed among these subjects. The results indicated that subjects from the eastern region have less knowledge about the environment, but actually they did more for the improvement of the environment. The finding of this somewhat inconsistent relationship between knowledge and behavior is similar to the finding of Gifford et al. (1983). The researchers found that college females expressed more positive attitudes and promised more commitment to the environment, yet they reported doing no more and actually knowing no more about the environment when compared to their male counterparts.

CHAPTER V SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The main purpose of this study was to assess preservice elementary teachers' environmental knowledge, worldview, attitudes, intention, and behavior. A related purpose was to examine the relationships among environmental knowledge, worldview, attitudes, intention, and behavior. More specifically, the research was designed to a) assess the environmental knowledge, worldview, attitudes, intention, and behavior of preservice elementary teachers; b) examine relationships among environmental knowledge, attitudes, intention, and behavior; and c) predict preservice elementary teachers' environmental behavior, intention, attitudes, worldview, and knowledge by examining their related predisposing and sociodemographic variables.

The population of the study consisted of preservice elementary teachers enrolled in the nine teachers colleges in Taiwan, Republic of China, during the spring semester of 1992. The sample was selected from the second-year students of the four academic disciplines of all teachers colleges in Taiwan. The nine teachers colleges were first classified into four regions according to geographic location. Within each region, one class from each of the four academic major

areas was randomly selected. The total number of subjects who participated in the study was 493 (male, 48.5%; female, 51.5%).

A survey questionnaire in a closed-end format was used to measure the study variables. The instrument included an environmental knowledge scale, a general environmental attitude scale, an environmental worldview scale, an environmental behavioral intention scale, an environmental behavior scale, and additional questions containing 10 items designed to collect sociodemographic information about the preservice elementary teachers including age, gender, academic discipline, high school course concentration, region of college location, residence, experience of environmental education, study interest, parental job, family economic condition, and political ideology. The reliability and validity of these scales was determined by their developers. The questionnaire was translated into Chinese by the researcher, and its translation was validated by a Chinese-American professor and three University of Florida Chinese Ph.D. students with majors closely related to the area of the present study. A pilot study using 28 University of Florida Chinese graduate students with varying academic majors showed that the Chinese version of the questionnaire was reliable. The survey was administrated to all students in attendance in the sampled classes on the day of survey. In order to

standardize the test procedure, all surveys were administered by the researcher under the assistance of the professor who was responsible for the class being sampled.

The data collected from the subjects were then analyzed by using the SPSS/PC+ package at the University of Florida Computer Laboratory. Descriptive data of this study were analyzed and presented as means and standard deviations, and frequencies and percentages. Data related to relationships among variables were analyzed by procedures of correlations and simultaneous multiple regressions.

The main findings in the present study are summarized. First, the means of the preservice elementary teachers' environmental knowledge, worldview, attitude, behavioral intention, and behavior were a) environmental knowledge, as measured by the Environmental Knowledge Scale, 9.33 (SD=1.96); b) environmental worldview, as measured by the NEP Scale, 39.14 (SD=4.52); c) environmental attitude, as measured by the Environmental Concern Scale, 47.83 (SD=5.83); d) environmental behavior intention, as measured by the Environmental Behavioral Intention Scale, 6.56 (SD=1.91); and e) environmental behavior, as measured by the Environmental Behavior Scale, 27.67 (SD=2.98).

Second, preservice elementary teachers' environmental behavior was significantly and positively correlated with environmental behavioral intention and environmental attitude, but not with environmental worldview and

environmental knowledge. However, environmental intention was significantly correlated with environmental behavioral intention, environmental attitude, environmental worldview, and environmental knowledge.

Third, preservice elementary teachers' environmental behavior was significantly predicted by the selected predisposing and sociodemographic variables. Among the four predisposing variables, only the behavioral intention variable was significantly related to environmental behavior. Preservice elementary teachers' environmental behavior varied according to their experience of environmental education, residence, and region of college location. On the other hand, their environmental behavior showed no difference according to age, sex, academic discipline, high school course concentration, economic condition, parental job, political ideology, and study interest.

Fourth, preservice elementary teachers' environmental behavioral intention was significantly predicted by the combination of the predisposing and sociodemographic variables. Among the three predisposing variables (environmental attitude, environmental worldview, and environmental knowledge), only environmental attitude reached the significant level. The subjects' environmental intention showed no difference according to all

sociodemographic variables studied except the political ideology variable.

Fifth, environmental attitude was significantly predicted by environmental worldview, environmental knowledge, and sociodemographic variables. Preservice elementary teachers' environmental attitude varied according to region of college location, economic condition, study interest, and parental job. Other sociodemographic variables studied did not affect the environmental attitude.

Sixth, environmental worldview was significantly predicted by the combination of environmental knowledge and sociodemographic variables. The subjects' environmental worldview varied according to environmental knowledge and academic discipline. Other sociodemographic variables did not affect the subjects' environmental worldview.

Seventh, environmental knowledge of preservice elementary teachers was significantly predicted by sociodemographic variables ($R=.33$, $p=.0001$). All sociodemographic variables studied could explain 11% of the variance in environmental knowledge. Preservice elementary teachers' environmental knowledge differed significantly according to academic discipline and region of college location. Other sociodemographic variables studied were not significantly related to environmental knowledge.

Conclusions

Based on the findings and within the limitations of this study, the following conclusions are drawn:

First, the instruments (environmental knowledge scale, environmental worldview scale, environmental attitude scale, and environmental behavioral intention scale) used in the present study were found to be useful in the evaluation of Chinese students' environmental concern. Preservice elementary teachers' environmental knowledge, worldview, attitudes, and behavioral intention as measured by these instruments were comparable to their Western counterparts. These instruments have provided a convenient means for cross-cultural comparison of environmental education.

Second, Green and Kreuter's (1991) PRECEDE model was found to be useful in predicting environmental behavior. It is recommended that the PRECEDE model be applied to health education planning and environmental education planning.

Third, the predisposing and sociodemographic variables selected by the present study were able to predict preservice elementary teachers' environmental behavior. However, the combination of these selected predisposing and sociodemographic variables could explain only 16% of the variance in environmental behavior.

Fourth, knowledge about the environment and its related issues seems to have limited direct effect on environmental behavior.

Recommendations

Based on the results of the present study, the researcher offers the following recommendations:

1. Replication of this study with other populations such as preservice secondary teachers and current teachers is recommended.
2. The present study has examined the preservice elementary teachers' general environmental concerns. More specific environmental concerns of preservice teachers need further investigation.
3. The selected predisposing and sociodemographic variables could explain only a limited proportion (16%) of the variance in environmental behavior. Therefore, further research is needed to examine more comprehensive variables related to factors predisposing, enabling, and reinforcing environmental behavior.
4. The present study examined only linear relationships between environmental behavior and selected predisposing and sociodemographic variables. Further investigations should be conducted to determine whether there are relationships beyond linearity between these variables.
5. The present study is a correlational study only. Further research using causal models and more sophisticated analysis techniques such as path analysis and LISREL to reveal the causal relationships between environmental

behavior and its predisposing, enabling, and reinforcing factors is needed.

6. It is recommended that further environmental behavioral studies sort factors affecting environmental behavior into predisposing, enabling, and reinforcing categories according to Green and Kreuter's (1991) recommendation to facilitate diagnosis and planning.

7. Environmental education is a relatively young discipline, and the theoretical background has not been well established. Some newly developed models other than the PRECEDE theory, such as that of Hungerford and Volk (1990) and Hines et al. (1987) deserve further research.

In addition, the following recommendations are made concerning the improvement for environmental education for preservice elementary teachers training in Taiwan.

1. Teachers colleges should provide courses concerning environmental education for all preservice elementary teachers, since it could significantly affect students' environmental behavior.

2. The courses in environmental education should be offered in the first or second year of teacher education, because at these levels such science-related courses may be more acceptable by the nonscience students.

3. In addition to providing general knowledge about the environment and related issues, skills and strategies about how to use the information also must be made available so

that students will know how to carry out these types of actions.

4. Environmental education for mathematics and science majors should be strengthened because they are expected to take the most responsibility for teaching elementary environmental education. However, they neither showed better knowledge nor reported doing more for the environment than their counterparts.

5. Nonscience preservice elementary teachers, especially the language education majors, appear to be in the best position to influence pupils' environmental attitudes and behavior, since elementary curriculum is concentrated in reading and writing. However, they apparently were least prepared based on this evaluation. Hence, providing a suitable curriculum that fits their interests and needs is essential.

6. Schools also should provide opportunities for students to participate in environment-related activities, e.g., recycling programs or on-campus environmental organizations. A number of students indicated that there were no environmental programs available on campus. Also, some other students expressed that their colleges provided few reading materials for them.

APPENDIX

QUESTIONNAIRE FOR STUDYING ENVIRONMENTAL SCIENCE EDUCATION NEEDS OF PRESERVICE ELEMENTARY TEACHERS

Dear Students:

1. This questionnaire is designed to collect information for the establishment of baseline data for the improvement of teachers college environmental science education. The information you provide on this questionnaire is confidential. Please feel free to answer all these questions.
2. It is not necessary to leave your name or any identification on this questionnaire; however, if you would like to know the results of this study, you may leave your corresponding address on the facing page of this questionnaire. The researcher will mail a summary of the results to you after the completion of the study.
3. The questionnaire is divided into six parts. Please read each question carefully and give your response according to the instructions provided on the top of each part.

Thank you for your assistance and cooperation!

Researcher: Liou, Jenn-Chang

PART I. ENVIRONMENTAL ATTITUDE SCALE

Please rate the following statements according to your own opinion.

- | | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|----------------|-------|------------|----------|-------------------|
| | 4 | 3 | 2 | 1 | 0 |
| 1. The federal government will have to introduce harsh measures to halt pollution since few people will regulate themselves. | 4 | 3 | 2 | 1 | 0 |
| 2. We should not worry about killing too many game animals because in the long run things will balance out. | 4 | 3 | 2 | 1 | 0 |
| 3. I'd like to make personal sacrifices for the sake of slowing down pollution even though the immediate results may not seem significant. | 4 | 3 | 2 | 1 | 0 |
| 4. Pollution is not personally affecting my life. | 4 | 3 | 2 | 1 | 0 |
| 5. The benefits of modern consumer products are more important than the pollution that results from their production and use. | 4 | 3 | 2 | 1 | 0 |
| 6. We must prevent any type of animal from becoming extinct, even if it means sacrificing some things for ourselves. | 4 | 3 | 2 | 1 | 0 |
| 7. Courses focusing on the conservation of natural resources should be taught in the public schools. | 4 | 3 | 2 | 1 | 0 |
| 8. Although there is continual contamination of our lakes and streams, nature's purifying processes soon return them to normal. | 4 | 3 | 2 | 1 | 0 |
| 9. Because the government has such good inspection and control agencies, it is very unlikely that pollution due to energy production will become excessive. | 4 | 3 | 2 | 1 | 0 |
| 10. The government should provide each citizen with a list of agencies and organizations to which citizens could report grievances concerning pollution. | 4 | 3 | 2 | 1 | 0 |

11. Predators such as hawks, skunks, and coyotes which prey on farmers' grain crops and poultry should be eliminated.
4 3 2 1 0
12. The currently active antipollution organizations are really more interested in disrupting society than in fighting pollution.
4 3 2 1 0
13. Even if public transportation were more efficient than it is, I would prefer to drive my car to work.
4 3 2 1 0
14. Industry is trying its best to develop effective antipollution technology.
4 3 2 1 0
15. If asked, I would contribute time, money, or both to an organization like the Sierra Club that works to improve the quality of the environment.
4 3 2 1 0
16. I would be willing to accept an increase in my family's expenses of 500 dollars next year to promote the wise use of natural resources.
4 3 2 1 0

PART II. SOCIODEMOGRAPHIC VARIABLES

Please answer the following questions by filling the blanks after the items or circling the number before the proper answer.

1. My birth date: ____, ____, 19____; or my age: ____.
2. My sex: 1)M ____ 2)F ____.
3. My current major is:
 - 1) Elementary Education
 - 2) Language Education
 - 3) Social Science
 - 4) Mathematic and Science
 - 5) Others
4. My senior high school major was:
 - 1) Natural science
 - 2) Social science
 - 3) Others (Please specify) _____.

5. Since my childhood, I have lived most of the time in a:
- 1) National city
 - 2) Provincial city
 - 3) County-level city
 - 4) Town or rural area
6. Generally, my family economic condition is:
- 1) Excellence
 - 2) Good
 - 3) Just OK
 - 4) Poor
7. The main person responsible for my family income is a:
- 1) General worker (labor worker)
 - 2) Farmer
 - 3) Businessman
 - 4) Teacher
 - 5) Private company employee
 - 6) Government employee
 - 7) Policeman or military personnel
 - 8) Others (Please specify) _____.
8. Have you taken any environmental education or environmental science?
- 1) Yes
 - 2) No
 - 3) Currently taking
9. Which of the following subject areas do you like most?
- 1) Language and literature
 - 2) Social Sciences
 - 3) Art, music, and other skills
 - 4) Mathematics
 - 5) Physics and chemistry
 - 6) Biological sciences
 - 7) Others (Please Specify) _____.
10. My political attitude seem more close to:
- 1) Current ruling party
 - 2) The main against-ruling party
 - 3) No partisan leaning
 - 4) Others (Please specify)_____.

PART III. ENVIRONMENTAL BEHAVIORAL INTENTION

Please read each of the following statements. Circle "T" if you agree with the statement; circle "F" for disagreement.

1. I'd be willing to ride a bicycle or walk to school in order to reduce air pollution. (T / F)
2. I would probably never join a group or club which is concerned solely with ecological issues. (T / F)
3. I would be willing to use a public transit system to help reduce air pollution. (T / F)
4. I am not willing to give up a weekend or holiday to join an activity related to environmental protection. (T / F)
5. I am really not willing to go out of my way to do much about ecology since that is the government's job. (T / F)
6. I would donate a day's pay to a foundation to help improve the environment. (T / F)
7. I would be willing to stop buying products from companies guilty of polluting the environment, even though it might be inconvenient. (T/ F)
8. I'd be willing to write my congressman weekly concerning ecological problems. (T / F)
9. I probably wouldn't go house to house to distribute literature on the environment. (T / F)
10. I would not be willing to pay a pollution tax even if it would considerably decrease the smog problem. (T / F)

PART IV. ENVIRONMENTAL BEHAVIOR

Please read all questions carefully and respond on the basis of your own behaviors to each statement.

1=Always 2=Often 3=Seldom 4=Never

1. Do you smoke?
1 2 3 4
2. Do you keep all faucets from leaking?
1 2 3 4
3. Do you participate school cleaning activities?
1 2 3 4

4. When you leaving a room in your house, do you turn off all electrical appliances and lights no longer needed?
1 2 3 4
5. How often do you read articles related to environmental issues?
1 2 3 4
6. How often do you use products in aerosol can?
1 2 3 4
8. In public areas, when you see litter, do you pick it up and dispose of it properly?
1 2 3 4
9. Do you sort your garbage into paper products, cans, and organic wastes for recycling?
1 2 3 4
10. Do you report pollution problems (industrial or individual caused) you see to the proper authorities?
1 2 3 4
11. Do support pro-environment candidates during a political campaign?
1 2 3 4

PART V. ENVIRONMENTAL KNOWLEDGE

Please answer the following questions by circling the letter before the most appropriate answer.

1. Soil pollution is generally due to:
A) sparse rains
B) improper farming methods
C) poisonous metals
D) overfertilization
E) poor crop rotation (C)
2. Most smog in our big cities comes from:
A) automobiles
B) supersonic jets
C) industrial plants
D) large trucks
E) refuse disposal (A)

3. High concentrates of chlorinated hydrocarbon residues:
- A) cause sheep to die
 - B) are found in large amounts in our atmosphere
 - C) accumulate in flesh-eating birds and upset breeding behavior
 - D) are not longer legal in pesticides
 - E) are readily biodegradable (C)
4. Mercury has been found at unacceptable levels in:
- A) fruit
 - B) vegetables
 - C) seafood
 - D) beef
 - E) soft drinks (C)
5. Which of the following does not appreciably reduce the pollution by automobiles?
- A) properly tuned engine
 - B) high octane gas
 - C) low lead gas
 - D) smog control devices
 - E) propane engines
6. The most common pollutants of water are:
- A) arsenic, silver nitrite
 - B) hydrocarbons
 - C) carbon monoxide
 - D) sulphur, calcium
 - E) nitrates, phosphates (E)
7. Ecology is best described as the study of
- A) the relationship between man and environment
 - B) the relationship between organisms and the environment
 - C) pollution and its control
 - D) the environment
 - E) recycling of products (B)
8. Which of the following substances is not related to the greenhouse effect of the earth?
- A) carbon dioxide
 - B) ozone
 - C) methane
 - D) chlorofluorocarbons (CFCs)
 - E) oxygen (E)

9. Birds and fish are being poisoned by:
- A) iron
 - B) mercury
 - C) silver
 - D) lead
 - E) magnesium (B)
10. All but one of the following decompose in ocean water:
- A) sewage
 - B) garbage
 - C) tin can
 - D) plastic bag
 - E) chemical fertilizer (D)
11. What is the harmful effect of phosphates on marine life?
- A) cause cancer
 - B) render fish sterile
 - C) induces nervous reactions in fish
 - D) makes water cloudy
 - E) feed algae which suffocates fish (E)
12. Which of the following well-known groups is primarily interested in conservation issues?
- A) 4-H Club
 - B) The Green Peace Organization
 - C) The Bird Watching Association
 - D) Boy Scouts of China
 - E) The Consumer Education Foundation (B)
13. Practically all of the lead in our atmosphere is caused by:
- A) cars
 - B) industrial plants
 - C) airplanes
 - D) burning refuse
 - E) cigarettes (A)
14. DDT takes how long to deteriorate into harmless chemicals?
- A) it never does
 - B) 10-20 months depending on the weather
 - C) about 200 years
 - D) about 400 years
 - E) anywhere from several days to several years (C)

15. Ecology assumes that man is: a (an) _____ part of nature.

- A) differential
- B) integral
- C) inconsequential
- D) superior
- E) original (B)

PART VI. ENVIRONMENTAL WORLDVIEW SCALE

Please rate each of the following statements according to your own opinion by circling the number under each item.

- | Strongly
Agree
1 | Mildly
Agree
2 | Mildly
Disagree
3 | Strongly
Disagree
4 | |
|---|----------------------|-------------------------|---------------------------|---|
| 1. We are approaching the limit for the number of people the earth can support. | 1 | 2 | 3 | 4 |
| 2. The balance of the nature is very delicate and easily upset. | 1 | 2 | 3 | 4 |
| 3. Human have the right to modify the environment to suit their needs. | 1 | 2 | 3 | 4 |
| 4. Mankind was created to rule over the rest of nature. | 1 | 2 | 3 | 4 |
| 5. When humans interfere with nature, it often produces disastrous consequences. | 1 | 2 | 3 | 4 |
| 6. Plants and animal exist primarily to be used by humans. | 1 | 2 | 3 | 4 |
| 7. To maintain a healthy economy we will have to develop a "steady-state" economy where industrial growth is control. | 1 | 2 | 3 | 4 |
| 8. Humans must live in harmony with nature in order to survive. | 1 | 2 | 3 | 4 |
| 9. The earth is like a spaceship with only limited room and resources. | 1 | 2 | 3 | 4 |

10. Humans need not adapt to the environment because they can
remake it to suit their needs.

1 2 3 4

11. There are limits to growth beyond which our industrialized
society cannot expand.

1 2 3 4

12. Mankind is severely abusing the environment.

1 2 3 4

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BIOGRAPHICAL SKETCH

Jenn-Chang Liou was born August, 16, 1948, in Tsu-San, a remote, mountainous area in central Taiwan. He graduated from National Taiwan Normal University with a B.Ed. in health education in 1972.

After his graduation, he taught at Wu-Chuan Junior High School in Taichung until 1982. In 1982 Mr. Liou was awarded a fellowship to study abroad from the Ministry of Education. He received his M.S. in nutritional science at the University of Michigan in 1983.

After receiving his master's degree he returned to his country and continued his teaching in Provincial Taichung Nursing Vocational Senior High School while he also taught at National Taiwan Normal University and China Medical College. In 1986 he joined Taichung Teachers College as an instructor.

In 1990 Mr. Liou was awarded a fellowship from the National Science Council for study toward a Ph.D. at the University of Florida. Upon completion of his studies, he will return to his country to continue his teaching at Taichung Teachers College.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Steve M. Dorman

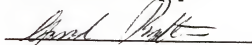
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